DOCUMENT RESUME

ED [illegible] 863 LI 002 923

AUTHOR	Svenonius, Elaine
TITLE	The Effect of Indexing Specificity on Retrieval Performance.
SPONS AGENCY	National Science Foundation, Washington, D.C.
PUB DATE	Mar 71
NOTE	425p.; A Dissertation Submitted to the Faculty of the Graduate Library School [Univ. of Chicago] in Candidacy for the Degree of Doctor of Philosophy
EDRS PRICE	EDRS Price MF-$0.65 HC-$16.45
DESCRIPTORS	Indexes (Locaters), *Indexing, *Information Retrieval, *Information Science, Information Systems, *Relevance (Information Retrieval)
IDENTIFIERS	Precision Ratios

ABSTRACT

The main purpose of the experiment was to answer the question whether broad or narrow terms function most effectively in the retrieval of relevant documents. The answer depends on what the user of the retrieval system wants, his wants being expressed in terms of stated precision-recall preference, or by the exact number of relevant documents he wishes to retrieve. Depth of indexing does not contribute significantly to effective retrieval. Documents should be indexed with broad terms to satisfy recall preferences with narrow terms to satisfy precision preferences since the amount of material retrieved in a system is not a simple function of the total numbers of terms posted to documents in the collection. At high cut-off values the retrieval power of broad and narrow terms tends to become equalized. Precision can be improved through raising the cut-off point and deleting broad terms. Experiments with weighted indexing provided poor results, and with title-term indexing gave inconclusive results. (AB)

THE UNIVERSITY OF CHICAGO

THE EFFECT OF INDEXING SPECIFICITY ON RETRIEVAL PERFORMANCE

A DISSERTATION SUBMITTED TO
THE FACULTY OF THE GRADUATE LIBRARY SCHOOL
IN CANDIDACY FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

BY
ELAINE SVENONIUS

CHICAGO, ILLINOIS
MARCH, 1971

ACKNOWLEDGEMENT

I wish to thank the Faculty of the Graduate Library School for the kinds of education of which this work is a by-product. In particular I want to thank Don R. Swanson for contributing to the motivation, criticism and imagination that impelled the dissertation to its conclusion. I thank also William Cooper for his steady substantive help, and Victor Yngve for encouragement in research philosophy.

Many others helped me in my work. I would like to thank John Metcalfe for reading and commenting on the dissertation. I am indebted to Sarah Houle for help at all hours in computer programming; to Victor Rosenberg for his help at the Computer Center; to Margaret Shaklee for help in key-punching and sorting data; to Sally Proesel for her expert typings of the dissertation; and to Leah Rae Miron for her meticulous proof-reading. I am especially indebted to Boyd Rayward for his commandments in the writing of prose and the sustaining of morale.

Finally, mention must be made of Gerald Salton and Cyril Cleverdon for the use of their data and of the National Science Foundation, who in part supported this work under grant numbers NSF GN 654 and NSF GN 432.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

CHAPTER I

THE MEANING OF SPECIFICITY

Introduction

The study undertaken here is in the area of indexing theory. The question to which the study is addressed is how specific should index terms be. So worded, the question poses difficulties. It is not clear, for instance, what is meant by "specificity." "How specific is specific?" is a question raised in the library literature whenever the "principle of specific entry" comes under discussion.

The specific entry principle is an injunction to catalogers to deal with language in a certain way -- to find the most specific subject heading for a work being indexed. It assumes that one can say in a reasonably simple way what a book or document is about -- specifically, where specifically is illustrated by reference to inclusive classes:

> Enter a work under its subject-heading, not under the heading of a class which includes that subject. Ex. Put Lady Cust's book on "The Cat" under CAT, not under ZOOLOGY or MAMMALS or DOMESTIC ANIMALS;[1]

The principle of specific entry is usually acknowledged as a

---

[1]Charles A. Cutter. Rules for a Printed Dictionary Catalog (Washington, D.C.: U.S. Government Printing Office, 1876), p. 37.

tenet inviolable in the practice of assigning subject headings. Indeed it would seem that no other principle or rule of indexing[1] enjoys a similar stature. Yet it has been observed that the relativity of the principle makes it difficult to apply or comprehend. A problem then in the study under consideration is to find a way of coping with the apparent elusiveness of the concept of specificity. In particular what is needed is a definition of "specificity" which is clear and distinct, suitable for use as a variable in a theoretical or experiment study of indexing effectiveness. In order to give something more than a speculative discussion of specificity, a procedure must be found for objectively evaluating indexing at varying levels of specificity. Such a procedure must include a method for systematically varying the specificity of indexing. Also required is a method for measuring which of the "more or less" specific indexings is the most effective in retrieval performance, in the sense of enabling users to find all and only those documents relevant to their needs. These are among the matters discussed in the following pages which propose an approach toward the problem of evaluating specificity in indexing.

There are four chapters. Chapter I discusses the background of the problem: the first appearance of a need for specific indexing in the nineteenth century and the consequent concern for specificity reflected in the development of subject and title catalogs. the continual confusion over the meaning of specificity, in particular the relativity of its meaning. Seven definitions of specificity

---

[1] The viewpoint is taken that in the assigning of terms to books or documents there is no essential difference between subject cataloging, information indexing and classifying.

are considered. One of these, called "operational specificity," is selected for use in an experimental study of indexing effectiveness. This definition is adequate in the sense that it gives a quantitative measure of the specificity of an indexed collection of documents and provides a method whereby the specificity of indexing can be varied in a systematic way. It is argued that this definition also reasonably explicates what is vaguely understood by "specificity" in the minds of those following the specific entry principle when assigning subject headings.

The core of the present study is an experiment designed to test whether specific indexing is better than non-specific or broad indexing. The experiment is a retrieval experiment; that is, documents are retrieved from an indexed collection of documents in response to search questions addressed to the collection. The output is then evaluated according to one of the usual measures of retrieval effectiveness. In the experiment the indexing of the document collection is altered by deleting sets of terms, broad terms and narrow terms. After each alteration in indexing, retrieval and evaluation procedures are carried out. Obtained thus are different measures of retrieval performance for indexings of varying specificities. The data used in the experiment is the Salton-Cranfield data, consisting of 200 documents in the field of aeronautics, 42 search questions addressable to the document collection and relevance judgments for each document with respect to each of the questions. Chapter II outlines the experimental design. Results are analyzed in Chapter III. Chapter IV summarizes the results and speculates on their practical applicability both within the constraints of

traditional library operations and with regard to what may be possible in libraries of the future.

Background

The problem of specificity made its appearance in the library literature in the middle of the nineteenth century. At this time there was indication of a growing dissatisfaction with the classed or classified catalog. Quite apart from the view which regarded the classification of books as a "logical absurdity,"[1] retrieval difficulties were encountered on a practical level. Samsom Low, for instance, complained that

> under the old system of classification (the classified catalog) the difficulty has always been to find a given title, though enabled to find a group of books published within a scientific discipline.[2]

As a response to the difficulties it was proposed that books should be indexed according to the words in their titles. Crestadoro was the foremost proponent of title-term indexing. Proposing a concordance of titles which "follows out each author's own definition of his book,"[3] he put his principles into practice first in the

---

[1]Jevon's famous remark. For an account of the theoretical opposition to classified catalogs see J. Metcalfe, Subject Classifying and Indexing of Libraries and Literature (New York: Scarecrow Press, 1959), p. 32 ff.

[2]Quoted in J. Metcalfe, Alphabetical Subject Indication of Information. Vol. III of Rutgers Series on Systems for the Intellectual Organization of Information, ed. Susan Artandi (New Brunswick, N.J.: Rutgers -- The State University, Graduate School of Library Service, 1965), p. 25.

[3]From his Manchester Catalogues. Quoted in J. Metcalfe, Information Indexing (New York: Scarecrow Press, 1957), p. 48.

British Catalog and then in the catalogs he prepared for the Manchester Public Free Libraries. Poole also advocated title-term indexing -- but with reservations:

> In most cases the author's own title best expresses the subject -- but if he has given it an obsolete or fanciful title, the indexer will give it a better one, and will place it under the heading where it naturally belongs.[1]

The import of the reference is clear. It is necessary that if some sort of rapport is to be established between the catalog and the catalog user, the catalog must use a language relatively free of surprises, one that is at least somewhat predictable. Crestadoro himself was quite aware of the weakness of title-term indexing and he warned the users of his catalog that some relevant items would be missed: "under any given subject the whole of the books . . . are not brought together, but only those in which the name of the subject occurs in the title."[2] The arguments for a uniform language and for completeness led to the development of the alphabetical subject catalog -- a catalog of standard subject headings alphabetically arranged. While dealing a "death blow"[3] to title-term indexing was a purpose in the creation of the alphabetical subject catalog, it was, however, subordinate to the more important purpose of providing a viable and constructive alternative to the classified catalog. The classified catalog, by permitting generic

---

[1]Quoted in Metcalfe, Alphabetical Subject Indication of Information, p. 27.

[2]Quoted in Metcalfe, Information Indexing, p. 48.

[3]Metcalfe in Information Indexing quotes Taylor as telling British students that "as far as British and American cataloguers are concerned, its (title-term entry) death blow was dealt by Cutter," p. 47.

entry only, made it difficult to find books on a specific subject. It was this lack of specificity that the alphabetical subject catalog was intended to remedy. The Principle of Specific Entry was stated by Cutter in 1876: "Enter a work under its subject heading, not under the heading of a class which includes that subject."[1] And in 1951 the raison d'etre of the subject catalog seems virtually unchanged: "The primary purpose of the subject catalog is to show which books on a specific subject the library possesses."[2] Somewhat regrettably perhaps, for it obscured the issues, the opposition of specific vs. generic entry continued to be regarded as part of the controversy over the relative merits of the two kinds of catalogs. The controversy goes on still today, though with diminishing force, especially in America where the alphabetical subject catalog is well entrenched in most libraries and the principle of specific entry is, in practice at least, everywhere accepted.

The Problem: Relativity of Specificity

Confusion has centered around the specific entry principle from the time it was first formulated at the end of the last century. A recent expression of the confusion is Dunkin's complaint, made in the summer of 1967:

> 'Specificity' is a magic word which we all accept but seldom really define. 'Specificity' means all things to all men and little to most, particularly when we are prepared to abandon our

[1]Cutter, Rules for a Printed Dictionary Catalog, p. 37.

[2]David J. Haykin, Subject Headings: A Practical Guide (Washington, D.C.: U.S. Government Printing Office, 1951), p. 1.

> definition at any point where the 'convenience of the public' can be argued.[1]

The question "how specific is specific?" is a recurrent one in the literature of library science. Often it is simply asked rhetorically for the purpose of showing that there exists a problem of viewpoint:

> How specific is specific entry? As shown, Cutter was specific when he used Shetland wool and Merino sheep, Framework knitters, Handloom weaver, and Pneumatic loom. But . . . Cutter was living in simpler times. Would he have been as specific as a model of a make of motor car for the model's manual; for example, the manual of the Morris Mini Motor Car?[2]

Perhaps the most direct assault on the relativity of "specificity" was that made by O.L. Lilley in 1955. He answered the question "How specific is 'specific'?" with "Well, it all depends!"[3]

Constructive answers to the question generally refer to a "public." Cutter, for instance, demanded that the specific entry principle be viewed in light of another principle, viz. the usage principle which requires that headings be chosen from the language of a particular public, the public for whom the catalog is intended, rather than from the indexer's own language or even that of the document. Metcalfe argued that, in practice, subject headings are not always as specific as the subject of the work and that one of the reasons for this is that the catalog user must get what he

---

[1]Paul S. Dunkin, "Cataloging and CCS: 1957-1966," Library Resources and Technical Services, II (Summer 1967), 284.

[2]J. Metcalfe, Alphabetical Subject Indication of Information, p. 35.

[3]Oliver L. Lilley, "How Specific is 'Specific'? " Journal of Cataloging and Classification, II (January 1955), 8.

wants by a name which he knows, without any guesswork on his part.[1] It is rather the indexer's obligation to guess at the degree of subject specification which will best serve his public. The public is the operative factor.

It is not immediately clear what good can be accomplished by introducing a public. It is doubtful, for instance, that a cataloger instructed to index a document as specifically as possible from the point of view of the public served is likely to have appreciably better insight into what he is doing than were he told simply to index with specific terms. Findings of a consensus set study conducted as part of an Indexing Project at the Graduate Library School suggest that while indexers agree on the important concepts to index, they alter these in various ways when verbalizing them into index terms, and that one of the most usual alterations is changing the level of specificity.[2] And again, in another study on the Indexing Project, it was found that disagreement about the choice of index terms is, in large part, attributable to a difference of opinion as to the appropriate length of phrase to be taken as an index term, again suggesting that much of the inconsistency among indexers is due to disagreement about degree of subject specification.[3] If on the appropriate degree of subject specification, coin-

---

[1]J. Metcalfe, Subject Classifying (New York: Scarecrow Press, 1959), p. 51.

[2]W. Boyd Rayward and Elaine Svenonius, "Consistency, Consensus Sets and Random Deletion," Studies in Indexing Depth and Retrieval Effectiveness (NSF GN 380) (Chicago: University of Chicago, Graduate Library School, 1967), p. 3.

[3]Ibid., p. 1.

cidence of point of view is rare among indexers describing the same document -- one wonders how much rarer still it must be between an indexer and a public who might find the document useful? After all, a public is single only when regarded as a vague undifferentiated mass; scrutinized more closely it appears fragmented into as many different points of view as there are individuals making up the public. Seen this way, one may agree with Lilley that "specificity may be so intangible as to be nothing more in an effective sense, than a chance relationship between the user's need of the moment and the format of a particular book an individual library happens to own."[1] Coming back to the question: how specific is specific? -- invoking a "public" would seem not to provide hope of a useful answer. It shows specificity to be entirely viewpoint dependent.

Questions of viewpoint are very like questions of relevance; both attest to the rights of individual imagination, and both work against the exploitation of language for the purpose of retrieving information. The position outlined above, which is ready to reject the concept of specificity because it is so much a matter of viewpoint,has a semantic parallel in a definite and rather extreme attitude towards language in general. According to this view the meaning of a word is a variable; it varies according to context. Some meanings are more stable than other, for instance those of technical terms, but even these are subject to flux, shaped by the meanings of contiguous words on the written page as well as by the

[1]Lilley, "How Specific Is 'Specific'? " p. 6.

net of associations elicited in the mind of an individual reader. Meaning is itself viewpoint dependent; so much so that it has been argued that no two uses of a word are quite the same, each use is a special case of meaning, there being no single meaning which is fixed and inviolate.[1]

The problem with specificity is in fact a problem in semantics, since specificity is a property of meaning. One word differs in specificity from another -- it is a rough way of saying that there is a difference in specificity of meaning. It is hardly surprising that specificity of meaning should be viewpoint dependent, when meaning itself is. Both vary according to context and individual mind-sets or dispositions towards the use of language. Lilley gives an example where the word Botany is specific in the context of departmental budgets, but general in the context of a group of botanists:

> Within the subject area of departmental budgets . . . the words "Botany" and "Geology" reasonably can be called specific terms . . . But in a group of botanists, if one individual were to remark that his special interest is "Botany", the statement would be so imprecise as to lack meaning for his hearers. In this instance "Botany" is no longer a specific term, but has become a very general one.[2]

Focusing on the relativity of specificity then may be regarded as a particular expression of a more general view of language. Carrying this view to an extreme, to a *reductio ad absurdum*, one can develop an argument for silence. Frege suggests that a word

---

[1]Ludwig Wittgenstein, Philosophical Investigations, trans. G.E.M. Anscombe (New York: Macmillan, 1953), see esp. p. 66.

[2]Lilley, "How Specific Is 'Specific'? " p. 4.

with vague boundaries cannot be called a word at all.[1] Rejecting so much rather commits one to semantic solipsism . . . as perhaps skepticism is the "price" of a too intense demand for certain knowledge.

> 'But is a blurred concept a concept at all?'--
> Is an indistinct photograph a picture of a person at all? Is it even always an advantage to replace an indistinct picture by a sharp one? Isn't the indistinct one often exactly what we need?[2]
>
> Wittgenstein, Philosophical Investigations

The main argument against semantic solipsism is that confusion and silence do not in fact represent what is generally the case. Language works in a dynamic way and words to be flexible enough for every occasion of their use must be somewhat vague and ambiguous. While this contributes to making language at some very basic level essentially private, it does not make communication impossible. A point to be noted in this connection is that it is possible for a word to be ambiguous in a very clear way. For instance pointer words such as "this" and "that" are extremely ambiguous, technically speaking, in that their possible referents are so extremely multiple; yet these words are generally used in such a way that their meaning is clear. There are really many situations where a "relative" word is needed. The meanings of words are stable as well as variable; it is a matter of degree. Meanings acquire a certain fixity inasmuch as they are used in accordance with lin-

---

[1]See quoted in Wittgenstein, Philosophical Investigations, p. 34.

[2]Wittgenstein, Philosophical Investigations, p. 34.

guistic habits or conventions. Wittgenstein likens these conventions and habits to rules of a game. There are really many language games, and their rules, more or less acknowledged, have the effect of forcing a degree of standardization more or less sufficient for communication and understanding. The notion of consensus is important here -- appealing to a consensus in the use of words to justify the possibility of communication, and in particular the retrieval of information. It is possible then, without denying the variability and conflict of viewpoints, to ask what is the nature and extent of the overlapping area of agreement about the specificity of index terms. Proof that there is some area of agreement is given in the Consensus Set Study mentioned on page 8.[1]

Another argument for not rejecting "specificity" on the grounds that it means different things to different people is that it may very well be a useful concept. Wittgenstein: "I use the name 'N' (substitute 'specificity') without a fixed meaning. (But that detracts as little from its usefulness, as it detracts from that of a table that it stands on three legs instead of four and so sometimes wobbles.")[2] This suggests an answer to the question: why, if no one seems to know what is meant by "specific," is the principle of specific entry so generally accepted? The answer here is a pragmatic one. Librarians have found the concept of specificity, as it is embodied in the specific entry principle, a useful one. It has served some purpose:

---

[1]Rayward and Svenonius, "Consistency, Consensus Sets and Random Deletion."

[2]Wittgenstein, <u>Philosophical Investigations</u>, p. 37.

> We librarians take no little pride in the fact that entries in our subject card catalogs are made under "specific" headings. This doctrine of specificity we tell ourselves (and others), not only simplifies our own task of putting information into the catalog, but in turn simplifies the user's job of getting the information out again;[1]

Lilley goes on to suggest that librarians in their pride are guilty of self-deception since the word "specific" has no fixed meaning. The answer to that is: nevertheless, the meaning may be as precise as it needs to be. The fact that the doctrine of specificity is so widely accepted strongly suggests that it "works." The argument of pragmatism is, like the argument of consensus, a rather standard ploy in staving off the skepticism entailed in a position of epistemological relativity. With "specificity" it is a question of linguistic relativity.

The Uses of Specificity

The worry about specificity in library literature arises in part from the fact that the specific entry principle seems to be regarded as useful. Arguments for the usefulness of the principle are principally of three kinds. The first holds that subject headings should be specific because the demand of users is for specific and detailed information. The second is that it serves as a decision-making device -- if the most specific heading is not assigned, then where among the lattice-like branchings of possible subject headings is the "best" one to be found? Thirdly, choosing specific subject headings is a way of insuring that too many entries do not

---

[1] Lilley, "How Specific Is 'Specific'?," p. 3.

accumulate under any one heading, a situation to be avoided because it would make searching tedious. These arguments are considered below.

Julia Pettee writes that the increasing specialization of civilization has created the need for specific and detailed information:

> it (our present dictionary catalog) arose in response to a demand of our highly specialized civilization for specific and detailed information. To gain this information from treatises or through some classified system is more laborious and time consuming than by means of alphabetical captions to which one can go directly without an intermediary symbol. Hence Cutter's primary rule for the dictionary catalog 'Enter under specific topic'.[1]

The same argument, that the public wants specific as opposed to "classified" information, is given by Metcalfe:

> This reaches down to the basic reason for Cutter's alphabetico-specific entry; the catalogue user must get to what he wants by a name of his subject which he knows, in an order which he knows, without any guesswork classification on his part.[2]

Whether or not the demand for specific information is real or by intuition only assumed, is still, as it has been for more than half a century, a matter of speculation and opinion. It is true there have been many statistical studies of users' needs, but these tend to be unsatisfactory because of defects in methodology and in the analysis of results and because of questionable start-

---

[1] Julia Pettee, Subject Headings: The History and Theory of the Alphabetical Subject Approach to Books (New York: H.W. Wilson, 1946), p. 57.

[2] Metcalfe, Subject Classifying, p. 51.

ing assumptions.[1] Most of these studies seem aimed at trying to find out whether the subject catalog is a useful device for finding information. The subject catalog, since it was developed in opposition to the classified catalog[2] and is based on the principle of specific entry, should, if Pettee's reasoning is valid, be useful to seekers of special and detailed information. The results of the studies, however, though admittedly tenuous, seem to indicate that no one would be greatly inconvenienced if the subject catalog were abandoned, at least in academic libraries: reference librarians rely mostly on reference works; research workers turn to subject bibliographies; and scientists have methods of their own.[3] Taking seriously these findings, one is led to wonder if perhaps this product, the subject catalog, that librarians are offering is not what it might be. In asking what might be wrong, the thought occurs that perhaps the principle of specific entry itself has in some way contributed to the catalog's failure to be relevant. By precluding broad subject headings when a specific one can be found, the principle has the effect of limiting access to the catalog. Broad terms may be useful. While a broad heading may fail to give a satisfactory description of a document, such a heading might, by its ubiquity, be reinforced in the memory of a user, and consequently be just the

---

[1]Carlyle J. Frarey, Subject Headings, Vol. 1, Part 2 of The State of the Library Art, ed. Ralph R. Shaw (New Brunswick, N.J.: Rutgers -- The State University, Graduate School of Library Service, 1960), p. 54.

[2]See pp. 4-6.

[3]Frarey, Subject Headings, p. 54.

one he would choose to look under. A word often seen can be readily remembered, there being no need for guess work or imagination. Further, the more specific the headings the less chance there is of the user finding all the material he needs under a given heading. For instance, a library may have no or a too brief account of the history of Virginia. However, a good deal on the history of Virginia will be found in histories of settlements in Eastern States. Thus even when the demand is for specific and detailed information, it could follow that this demand is more often satisfied in a system which can permit the user to broaden a search in a meaningful way when he is not immediately satisfied by what the system yields under a specific heading. Pettee's argument seems weak. For subject cataloging and indexing in general, the question of whether broad or narrow terms are preferable seems independent of the "steadily increased demand for specific and detailed information."

The second argument for the need for a principle of specific entry is based on the usefulness of the principle in making decisions -- if not the most specific heading, what then. The possibilities are too many. Haykin uses this argument:

> It is necessary, however, to state the reason for the use of the most specific heading applicable, rather than the broader heading which comprehends it.
>
> If the subject catalog were to consist of a predetermined number of more or less broad headings, a work on a specific topic would have to be entered under the broader one. The broader heading would thus be used for works as comprehensive as the heading, as well as for works on all the topics comprehended by it. To find out whether the library possesses a book on a specific topic, the reader would, in the first place, need to know how broad a heading might be used for it, and, in the second place, would have to scan all the entries under the broader heading in order to select those

> which are of interest to him . . . a reader looking for material on the income tax can be sure of finding it quickly and surely only by looking under the heading Income Tax. If the library were to choose a broader heading, it would have to be Taxation or even Finance, Public. Obviously, the number of entries under either would be relatively large in any library. The reader could not, in any case, be certain that he had hit upon the heading which the library has, more or less arbitrarily, chosen for topics related to and including the income tax . . .[1]

This argument -- and Pettee's as well -- seems to be backed by the belief that a certain economy must be observed in the assigning of subject headings, *viz*., that the choice between a broad or specific heading must be an either-or-but-not-both option. The either-or assumption, however, cannot be immediately dismissed. For one thing, belief in it has been strong enough to energize the century-long controversy over the relative merits of the classified *vs*. the alphabetic subject catalog, the classified catalog providing for "generic" entry. Though from a logical point of view it is a misleading use of the concept of class, in the language of library literature "classified" is often regarded as "nonspecific." Cutter, for instance, in stating the specific entry principle uses "class" by way of a negative definition: "Enter a work under its subject-heading, not under the heading of a class which includes that subject."[2] The dichotomy is partly physical in that the arrangement of a catalog can be classified or alphabetical but not both. But partly also it is the dichotomy of whether a user wishes to find under a heading all or most documents relevant to his needs, at the expense of going through many irrelevant documents, or whether he

---

[1]Haykin, *Subject Headings: A Practical Guide*, pp. 9 and 10.

[2]Cutter, *Rules for a Printed Dictionary Catalog*, p. 37.

would prefer to avoid examining a large number of irrelevant documents, but at the price of missing many of the possible relevant ones. This is the problem of whether it is better to maximize recall, the percentage of relevant documents retrieved, or to maximize precision, the percentage of retrieved documents which are relevant. A "tradeoff" seems to hold, for the most part: any improvement in recall results in a loss in precision, and, conversely, that a bettering of precision makes for poorer recall. The choice between all or only relevant material is not unrelated to the choice between broad or specific headings. Samsom Low's argument against the classified catalog, mentioned on page 4, seems to be an argument against access through broad terms and their potentiality for eliciting irrelevant material. The de facto as well as the theoretical history of library catalogs might be viewed as an attempt to reach some sort of acceptable compromise between broad and specific terms. Metcalfe points to "the steadily increased use of specific entry through the 19th and 20th centuries in the face of continuing propaganda for classified entry"[1] -- which perhaps suggests not compromise really, but a tendency to favor specific terms over broad ones, good precision over good recall.

On the other hand, the generic-specific controversy and the either-or assumption on which it is based could be misleading. It is not clear why access through broad or specific terms should be thought to exclude each other. It seems natural to ask why not have both: why not let the indexer choose all possible terms which seem

---

[1]Metcalfe, Alphabetical Subject Indications of Information, p. 16.

applicable, broad as well as specific, and let the user have the option of choosing the generic level at which he wishes to enter the system. The user would be well-served. He could, for instance, himself choose precision at the expense of recall, or *vice versa*, depending upon the specificity or size of his requirement. This is the question of "double entry," and in the literature there are arguments pro and con. On the pro side Pettee points out that Cutter's rule for "specific entry" does not forbid the practice of double entry. He says 'that if room can be spared, the cataloger may put what he pleases under an extensive subject (a class), provided he puts the less comprehensive works *also* under their respective specific headings.'[1] And then Pettee goes on to observe that this practice of double entry "arose in response to the demand for ready reference which is the major function of the small and medium sized public library." "There is no doubt," she adds, "that these libraries have been benefitted far more than they have been inconvenienced by this practice."[2] As reasons for not using double entry are cited the "cataloger's fallible judgment"[3] and the fact that the "inconsistencies of these duplicate entries have caused much confusion."[4] The inconsistencies and confusion presumably arise from the element of imagination which is introduced when catalogers are allowed to use subject headings more generic than the

---

[1]Pettee, Subject Headings: *The History and Theory of the Alphabetical Subject Approach to Books*, p. 69.

[2]*Ibid.*, p. 71.

[3]*Ibid.*

[4]*Ibid.*

subject of the work being cataloged; the cataloger's imagination may lead to the user's bewilderment. But this argument is not very convincing if, as Cutter advises, broad headings are used only to supplement and not to replace the specific ones. Another, and seemingly stronger, argument against double entry is that the license it permits would burgeon the catalog with an unwieldy "reference apparatus," disproportionate to the number of actual items processed.[1] The danger of filling up the catalog is seen to be especially serious in the case of large research libraries. Pettee writes:

> Certainly these duplicate entries should be carefully considered and watched, but it is only when the collections assume vast proportions and take on the major function of research that measures of more control and elimination become imperative.[2]

There is then some fear of losing control as the catalog increases in size and complexity. One might speculate that the fear need not necessarily be met by inhibiting the growth of the catalog. The possibilities offered by the computer might be seen as providing an alternative, in that the computer, as an organizing device, could make wieldy an elaborate reference apparatus far better than a physical collection of cards.[3] In particular there would be no need to

[1]Frarey, Subject Headings, p. 59.

[2]Pettee, Subject Headings: The History and Theory of the Alphabetical Subject Approach to Books, p. 71.

[3]The statement needs qualification. Unconstrained by the conventional image of a card catalog, the mind can imagine an enormous reference apparatus structured in physical space in a way that would permit a staff of thousands to perform searches. Manual access, theoretically at least, need not be clumsy or tedious. Ultimately the choice between a computerized system and a manual one is a matter of cost.

choose either a classified or an alphabetical access method, since both would be possible. One entry only would be needed for each bibliographic item, and as many generic and specific added subject entries as needed could be provided in the form of an index. Moreover, were the new media to prove economically feasible as well, the rationalization that users demand specific and detailed information would become superfluous -- and also some users' studies -- since users could demand anything they wanted and be satisfied.

The third reason given for the practice of specific entry is that it serves to break up a collection of books or documents into clumps of a reasonable size. This is perhaps the most important reason -- at least it has been impossible to discuss the other two reasons without sensing the existence of this one in the background. The reasoning is that there must be upper and lower limits to the number of books posted to any given heading. For instance, a user would not be happy consulting a heading such as History--U.S. if all books in the library on this subject, no matter how incidently or specifically "related," were collected under this heading. The heading does not have sufficient discriminating power and thus imposes on the would-be user the tedium of too much retrieval. That libraries are sensitive to the problem of over-retrieval is evidenced by the fact that where a very broad heading cannot be subdivided naturally, other devices, such as subdivision by publication date, have been suggested to control the number of postings to the heading.[1]

[1]See Sidney L. Jackson, "Date Treatment of Broad Headings in Thirty Major Libraries: a Report with Comments," Journal of Cataloging and Classification, IX (March, 1953), 21-24.

On the other hand it can be argued that subject headings can be too special, scattering the collection so much that the organizing potential of subject indexing is unrealized. In the extreme and limiting case where each different book is assigned a different heading, the bibliographic situation is as disorderly as if no heading were assigned at all. The limits of specificity have been remarked by Pettee:

> The present tendency of the Library of Congress is to use very specific terms. As the choice between the most specific term (which can be used as a heading) and a more inclusive one depends entirely upon the number of items which will be likely to collect under the more inclusive term, a safe rule would be to prefer the more inclusive for less than a dozen titles which would be likely to collect under it. Collecting half a dozen books on trees of various kinds under the term Trees, serves the clientele of the very small library better than scattering them under Elm trees, Firs, Hard woods, etc. The larger collection will need the specific terms. The choice demands judgment on the part of the cataloger based upon actual knowledge of his particular readers' reactions to the catalog.[1] (my underlining)

Similar reservations about too much specificity have been made by Henry B. Van Hoesen[2] and by Haykin,[3] the point being there is a limit beyond which the number of books retrieved by any one heading cannot be sacrificed. It seems clear that an important function of the specific entry principle is to control what could be called

---

[1]Pettee, Subject Headings: The History and Theory of the Alphabetical Subject Approach to Books, p. 81.

[2]Henry B. Van Hoesen, "Twelve Rules for Economy in Subject Headings," an Appendix in Pettee, Subject Headings: The History and Theory of the Alphabetical Subject Approach to Books, p. 163.

[3]Haykin, Subject Headings: A Practical Guide, p. 10.

the "operational breadth" of subject headings. Vigilance is necessary in keeping down (or up) the number of catalog cards piling up behind one heading.

The Definition of Specificity

The last section of this Chapter has discussed the function of the specific entry principle and attempted to single out the factors which over time have proved its usefulness. The question to be considered in the present section is whether there is some common ground for understanding the concept of specificity. The answer is approached by elaborating seven different types of specificity, or specificity relations, on which one might expect to find more or less agreement. While this may be regarded as an exercise only in language analysis, it is perhaps exactly what is called for in trying to understand a concept generally agreed to be relatively vague, amorphous, etc. Each of the seven definitions of specificity represents only a partial explication of what is meant by the concept, but each does something towards clearing part of the confusion.

To begin with, it can be observed that it is often not the concept *per se* which causes trouble. The abstract concept of specificity is after all somewhat of a reification. The trouble is more particularized. Disagreement arises in special cases where it is difficult to decide whether one word is more specific than another. The relation of specificity (*a* is more specific than *b*) may or may not hold between two words (strictly: between two senses of meanings). For instance, *dog* is more specific than *domestic animal*, while *dog* and *icebox*, as far as any specificity relation goes, might well be

considered to be incomparable. It happens, but it is not so common, that the specificity relation holds between two different senses of the same word. *Algebra*, denoting a special kind of mathematical system ("a ring whose elements can be multiplied by elements of a specified field in accordance with special rules") is more specific than *algebra*, meaning the modern algebra which treats of the deductive properties of all such mathematical systems. The problem of specificity can be perceived then in terms of specificity relations. Given two words, *a* and *b*, it can be asked how much consistency is there in judgments of the type: *a* is more specific than *b*; that is, how unambiguously is the specificity relation defined.

i. There is a sense in which the specificity relation can be defined completely and unambiguously. This is to regard it as the mathematical relation of inclusion. As the inclusion relation is normally defined, it is reflexive, antisymmetric and transitive.[1] The relation is understood as holding between classes or sets of elements, which makes possible another definition, this one in terms of set membership: one class A is included in another class B if all the members of A are also members of B. A point of some interest to note is that in the abstract theory or calculus of classes it is always possible, given a non-empty class, to find a different class which is included in this class. Given any non-empty class one may separate off those members which satisfy some condition and

---

[1]These conditions are formulated as follows:

reflexivity $A \subseteq A$
antisymmetry $A \subseteq B + B \subseteq A \rightarrow A = B$
transitivity $A \subseteq B + B \subseteq C \rightarrow A \subseteq C$

See Patrick Suppes, *Introduction to Logic* (Princeton, N.J.: D. Van Nostrand, 1957), Chap. 10.

form the class consisting of just those members. For instance, knowing that the class of mammals exists, one can assert the existence of a class of mammals which have the further property of being reasonable. Thus the property "reason" enables man to be separated from mammals in general. The example is a little misleading since in a formal mathematical language, such as the theory of classes, there are no "meanings" attached to the elements of the language; classes and their members are represented by letters, not by names such as "mammal" or "man." The theory of classes is an abstract language, yet it is one in which there can be no doubt at all as to what is meant by inclusion, whether one class is included in another. Unambiguously defined by postulates, the inclusion relation is independent of "meanings" in the ordinary sense; it is very much above exception or disagreement. Specificity defined in terms of the mathematical relation of inclusion could be called "formal specificity." Formal specificity is too precise to have more than a very limited application, but it is important because it can be seen to represent or model in a pure, idealized form other more interesting (and more confusing) types of specificity in ordinary language.

ii. In meaningful or colloquial language the inclusion relation is often used with nearly the same precision as in an abstract mathematical language; in these uses it satisfies the same properties of reflexivity, antisymmetry and transitivity. Presumably in all natural languages there are some words which, more appropriately than others, can be characterized as class terms. These are the words which quite naturally lend themselves to extensional definition. The

extension of a word covers all the objects denoted by the word. _Cat_, for instance, can be defined as the class consisting of all cats. The definition is understood by forming the class in a mental way, that is, by abstracting from all things a common characteristic, in this case "catness." Similarly one can form the class of domestic animals, and in the process of abstraction it is seen that all those things characterized by catness are domestic animals as well. It would be fairly agreeable then to conclude that _cat_ is more specific than _domestic animal_. Only "fairly" because one might pause to reflect, for instance, that a panther can be called a cat but not a domestic animal. It is possible that the extension of any so-called class term can be toyed with, given sufficient imagination. But there are even more confusing difficulties when trying to make decisions about class membership. For instance, are nectarines peaches? The dictionary has it so, but then goes on to point out that "nectarines may arise from peaches or peaches from nectarines." Taking these reservations as limiting but not controverting, it does seem that there is a large domain in ordinary language where the use of the specificity relation follows closely the rules of logic. This is where words can be extensionally defined in a relatively clear way.

There is trouble at once, however, when this concept of specificity is extended beyond its legitimate domain to other parts of language, for instance to abstract words such as _good_, _true_, and _beautiful_. It is difficult to define these words by extension. One of the characteristics of words which can be extensionally defined

is that their meanings can be taught ostensively.[1] That is, it is possible to demonstrate the meaning of cat simply by pointing to different cats, however many cats are necessary to give someone the inductive ground for establishing an association between the word and the thing. Abstract words, on the other hand, are not so strongly referential. Only in a Platonic heaven can the good, the true and the beautiful be pointed to. It can be asked if there is a relation of specificity holding between these abstract words. The question is not silly, it seems a consequence of the demand for grounding abstract words, the demand for reference posts to make meanings more precise. It proved a source of difficulty for Plato who believed, and did not believe, that the idea of beauty, as well as the idea of truth, "participated in" (was included in) the idea of the Good. Common sense rebels. It seems as though "specificity" has got out of hand here -- testimony perhaps to the dictum that "philosophical problems arise when language goes on holiday."[2] The relation of class inclusion is a compelling one and attractive. Classifying is a fundamental operation of the mind, fundamental to the ordering of thought and experience. But there can be too much order. The meaning of the inclusion relation is fairly precise, fairly close to its mathematical meaning, when it is used between words which are clearly referential, but as its use is gradually extended to the more heady realms of language, its meaning becomes more diffuse,

---

[1]See Williard van Quine, From a Logical Point of View (Cambridge, Mass.: Harvard University Press, 1953), p. 65 ff.

[2]Wittgenstein, Philosophical Investigations, p. 19.

more vague, more subject to the dispute of viewpoint.

iii. There is, however, one extension of the inclusion relation into the domain of nonreferential language which seems more warranted than others because of the exactness and simplicity with which the boundaries of this domain can be drawn. In effect, the ambiguity of the relation is controlled by stating a rule which makes it possible to see immediately when the relation holds. This rule can be seen as an extension of the operation mentioned earlier (p. 25) which allows one to form a subclass of a class by introducing a distinguishing characteristic -- mammals plus eason, for instance, gives reasonable mammals or men. This separating operation, used in the abstract uninterpreted language of classes, may be taken as a syntactic analogue of one of the most basic semantic operations employed in ordinary language, namely the operation of modifying. The analogy perhaps is what reinforces the impetus to extend class inclusion beyond words which are clearly referential to words of a more abstract nature: from, say, <u>reasonable</u> <u>mammals</u> to <u>atomic</u> <u>physics</u>. It is fairly easy to "picture" the subclass of mammals that are men; it is not so easy to grasp in a conceptual way the elements which form the subclass of physics that is called atomic physics. On the other hand, no one would dispute that atomic physics is a special kind of physics, and thus is more specific than physics. For the most part modification leads to specification. "For the most part" because unfortunately the operation is not always well-behaved. Anomolies can arise. For instance, it is difficult to regard metaphysics, in the sense of "supra-physical" as

being specific to physics. The trouble is that not all modifiers pare down the meaning of the words they modify. A particularly troublesome case -- and again one of Plato's worries -- is that of negative modifiers (eg., not) which exploit the words they modify in such a curious way. These modifiers are perhaps not numerous, and at first sight it would seem that they can be rather easily identified. One might thus relegate them to a stop list, so that, with clear exceptions, the rule would still hold that a modified word is more specific than the same word unmodified. This rule deals with pairs of words (strictly: word phrases) between which the relation of semantic specificity holds. It singles out and isolates a special kind of hierarchy. This has been called "phrase-length hierarchy" by Swanson and has been studied earlier on the GLS Indexing Project.[1] One can without misunderstanding also call it "phrase-length specificity." The great advantage of phrase-length specificity is that the specificity relation is defined in a thoroughly clear-cut way, independently of intuition and -- assuming a stop list of troublesome modifiers -- in no way counter to it. The price paid for the disambiguation is that the domain in which the relation holds seems too partial, at least as the specificity relation is usually understood. For instance, it does not hold between the words man and mammal. It is difficult to get some idea of the extent of this partialness. In the context of the retrieval of technical information, it is perhaps not very usual to find modified noun phrases called by other names, for instance the way

[1]Rayward and Svenoni , "Consistency, Consensus Sets and Random Deletion," p. 4.

rational mammal is dubbed man. In any case there is a significant amount of straight modification; and thus there is a significantly large and well-bounded area of language where "specificity" can be said to be viewpoint free.

iv. In the language of mathematics and in that of natural language where meanings are clearly referential or are related by easy modification, the specificity relation is neither relative, nor vague, nor ambiguous. The precision in each case, however, is gained by limiting the domain in which the relation of specificity can legitimately hold. But how useful are these definitions when it comes to making decisions in the structuring of library classification schemes intended to map extensive areas of language, perhaps language as a whole?[1] Semantic tree structures, such as library classification schemes, subject heading lists and thesauri represent partial orderings of words; the relation which accomplishes the ordering is implicitly, even explicitly sometimes, modeled on the ideal logical relation of class inclusion.[2] Quite often the structure of the subdivision of a library classification does correctly express class inclusion -- but very often it does not. Fairthorne gives an "excrutiating" example where the condition of transitivity is violated:

---

[1]The Dewey and L.C. classifications might be understood as mapping all of language, since they are intended to handle books on every subject.

[2]Thus in his An Introduction to Library Classification, Sayers writes:

> here is an excrutiating example from the U.D.C. 681.1, Apparatus with Wheel Mechanisms, includes 681.14, Calculating and Adding Apparatus, which includes 681.143.2, Slide Rules. Slide Rules have taken weird shapes in their time, but they are not apparatus with wheel mechanisms. Somebody forgot that not all calculating apparatus has wheels or, more likely, did not bother to look at the main heading.[1]

It seems unlikely that someone "forgot" or "did not bother to look at the main heading" since it is not difficult to find other similar "mistakes" in classification schedules -- mainly because different principles of division are used to form subclasses down the line, partly because headings are just placed somewhere because there is nowhere else to put them. Subject heading lists are also to some degree structured on the relation of inclusion.[2] It is in

---

> It is clear that in a classification difference is the determining factor of division itself. Likeness makes the genus, i.e., draws all the species or all the things having it into one family; difference is the something added to these things which abstracts the species or members of the family. In outline, our classification of man shows that

Genus	Difference	Species
zoology	sensibility	animal
animal	backbone	vertebrate animal
vertibrate	viviparous quality	mammal
mammal	reason	man

> Every classification must prodeed on some such lines as these.

From W.C. Berwick Sayers, An Introduction to Library Classification (8th ed.; London: Grafton, 1950), p. 27.

[1]R.A. Fairthorne, "The Mathematics of Classification," Towards Information Retrieval (London: Butterworths, 1961), p. 6.

[2]Pettee writes: "Under the particular topical heading all aspects of the topic may be collected. These particular topics

the "see also" structure of subject heading lists that the inclusion relation is reflected.[1] And again it is used imperfectly, though in this case at least, the deviation from strict inclusion is both conscious and intentional. It is also a matter over which there has been considerable disagreement.[2] The problem is whether the directioning of "see also" references should be reserved for going from general to specific, or whether they should be used also to indicate coordinate relationships. It is a problem of deciding between a rigorous inclusion (specificity) relation or a more flexible, but vaguer, relation of association. The problem is somewhat academic, since in practice the decision is already made -- in favor of the liberal alternative.[3] In any case it is clear that there

---

dispersed through the alphabet must still be considered parts of a larger whole with interrelationships to many allied topics. An alphabetical subject catalog as well as a classed catalog must take into account these interrelationships, and to determine them a logical analysis of the topical groups is necessary."
Pette, Subject Headings: The History and Theory of the Alphabetical Subject Approach to Books, p. 59.

[1]In the introduction to Sears List of Subject Headings one reads: "In general, 'see also' references are made from the general subject to more specific parts of it, and not ordinarily from the specific to the general."
Sears List of Subject Headings, ed. Bertha M. Frick (8th ed.; New York: H.W. Wilson, 1959), p. 25.

"Not ordinarily," but sometimes, and the reference in both directions violates another of the conditions used to define the relation of inclusion, viz., that of antisymmetry. In fact the very first entry in Sears List that uses a "see also" shows a downward reference from abbeys to convents and nunneries--monasteries, as well as a reference from convents and nunneries--monasteries to abbeys.

[2]See Frarey, Subject Headings, p. 42 ff., p. 60 ff.

[3]In rationalizing the decision, Pettee on the structure of subject catalogs writes: "The logic transcends the limits of a classi-

are more relations in both a library classification and a subject heading structure than can be expressed by any strict theory of inclusion.[1] One might say that the specificity relation when it is used irregularly or imprecisely -- as in the slide rule example -- becomes unmoored from its logical foundation, and is, thus, corrupted. Though it is perhaps truer to say that a mathematically precise concept of specificity is not so much corrupted as simply found wanting, when it comes to mapping a larger area of language.

But there is an alternative precision to the mathematical precision which is achieved by the setting up of postulates or conditions. A relation, such as the specificity relation, can be defined exactly by an explicit enumeration of all the pairs of objects (words) for which the relation holds. In other words, a consensus of judgment about specificity (slide rules are more specific than apparatus-wheel mechanisms) need not derive from reason or rules of logic. A consensus can be obtained by force, and this seems to be what happens in practice. The structure of a subject heading list such as Sears must be taken as given; hierarchy is what its authors choose to call hierarchy, the relation of specificity is defined by enumeration.

---

fication scheme, for the interrelationships of the special topics reach out into the whole field of knowledge . . . The interrelationships brought together under names in the dictionary catalog are impossible in the logical sequence of strict classification lines." (Pettee, Subject Headings: The History and Theory of the Alphabetical Subject Approach to Books, p. 59.) As was indicated earlier, classification schemes are not particularly limited by considerations of logic. But this is a matter of degree, and Pettee's observation is probably good as a black-white picture of the emphatic difference between subject heading lists and classification schemes.

[1]See Elaine Svenonius, "Library Classification Lattices," Master's Thesis (Chicago: University of Chicago, Graduate Library School, 1965).

There can be no disagreement about the relative specificity of two subject headings, since one can see whether a specificity relation holds in one direction, in both, or not at all, simply by consulting the List to see where in the established hierarchy the headings are located. The List is very definitely an authority list, whose purpose is to impose standardization, to curtail the cataloger's rights of imagination for the sake of uniformity. Catalogers are cautioned about departing from the List, even in the eventuality, which seems probable enough, that a "new" subject emerges.[1]

This juggernaut quality of the List has quite naturally been cause for complaint, though usually authority lists do leave room for some flexibility in the use of the terms they contain.[2] The permissiveness allowed, however, is not so much in judging what is specific to what, but rather in choosing the degree of specificity at which a particular library wishes to operate. (As will be suggested later, as concerns libraries this is perhaps the proper con-

---

[1] "Tentative headings can be assigned, perhaps written in pencil on the cards to be used until the terminology becomes standardized. A list of these tentative headings should be kept (it will never be long) so that they can be reconsidered later and either adopted permanently or changed, as the case may be, and added to the list." (Sears List of Subject Headings, 8th ed., p. 27.)

[2] In the Preface to the ninth edition of Sears, Barbara Westby writes: "A common criticism of any list concerns the degree of specificity in its headings. Specificity is relative and depends on the size of a library, its function, and its patrons. In a small collection, the use of too specific headings can result in scattering like materials. Practicality rather than theory should determine the degree of specificity. Sears, by example or instruction, suggests 183 classes of headings that may be added by the cataloger. The provision of 126 subdivisions further increases the degree of specific entry a library may use." (Sears List of Subject Headings (9th ed.: New York: H.W. Wilson, 1965), p. 6.)

text in which to discuss the relativity of specificity, one where the problem is real.) Not only is there some permissiveness in an authority list, but the government it imposes is not entirely arbitrary. Terms used for subject headings must conform to current American usage:

> As a general rule, however, when a term sanctioned by American usage is available for an object (or group of objects), a concept, or a relationship, it may be used as a subject heading. Under this principle there is justification for such specific headings as Autumn, Quatrain, Ultrafax, Waltz.
>
> In fine, a subject heading used in the modern dictionary catalog or alphabetical subject catalog represents a choice of that term to designate the subject which is to be used consistently regardless of the language of the author. This term must, if possible be sanctioned by current American usage.[1]

The making of an authority list, like the making of a dictionary, is not a willful or whimsical undertaking. It happens sometimes that a dictionary definition does not do justice to the contextual subtleties of usage of particular words, but,whether one accepts a definition or not, one still uses a dictionary. If a library user does not consult a subject-heading list, then possibly it is because he already has enough familiarity with the bibliographic mapping of the collection or he has found that that mapping is close enough to a use of language with which he is familiar. Any difficulties that arise because of a divergence between his own language and that of a library can in part be resolved by a simple consultation with a subject headings list. The most compelling reason for coercive specificity is that the consistency it creates

---

[1]Haykin, Subject Headings: A Practical Guide, p. 11.

furthers the chances for a dialogue between the catalog and a library user.

v. Uriel Weinreich writes that one of the major motivations of semantic research is "a desire to analyze global meaning into components."[1] It has been suggested by Thyllis Williams[2] that a quantitative measure of semantic specificity be based upon the results of this kind of componential analysis. In developing the idea, Miss Williams focuses her attention on a special class of word meanings, viz., meanings which are "commonly accepted" in the sense that they can be found in a standard pocket dictionary. A thesaurus constructed of hierarchies of these word meanings can be obtained by turning a dictionary "inside out," that is,by subordinating every defined word (strictly: word sense or meaning) to each of its defining words. Roughly, the specificity of a word is proportional to the complexity of its definition. Man is more specific than mammal because to the definition of mammal one must add another component, viz., the distinguishing characteristic "rational." Intuitively it would seem that there must be some correlation between the specificity of a word and the number of components used in its dictionary definition. It is apparent at once, however, that certain qualifications must be made. First, not all the components in

---

[1]Uriel Weinreich, "Explorations in Semantic Theory," Universals of Language, report of a conference held at Dobbs Ferry, N.Y., April 13-15, 1961, ed. Joseph H. Greenberg (Cambridge, Mass: M.I.T. Press, 1963), p. 405.

[2]Thyllis M. Williams, "Standardized Abstracts of Dictionary Definitions," Studies in Indexing Depth and Retrieval Effectiveness (NSF GN 380/654) (Chicago: University of Chicago, Graduate Library School, 1968).

a dictionary definition are equally significant. For instance some prepositions and other common words are not particularly descriptive and they therefore contribute little to the meaning of the word being defined. The problem becomes more complex when one realizes that there is no sharp boundary between words which are descriptive and those which are not; words are only more or less descriptive. Secondly the syntax of the definition must be considered. Words which are used disjunctively in a definition (eg., "new" as defined as "recently discovered, recognized or learned about") can be regarded as contributing essentially less to the definition than words not so used ("inquiry" defined as "a request for information"). More examples could be given and of a more complicated nature, the point being that the analysis of dictionary definitions requires thoughtfulness and care. Consistency requires that such an analysis follow a well-defined set of rules. The result of applying these rules to a dictionary definition is called a "definition abstract." The definition abstract consists of the components of the definition selected as significant, and a weighting of these components according to their significance.

Having thus obtained definition abstracts of words, it would seem that the specificity of the words could then be measured by counting significant components. But even this is too simple because the complexity of the components themselves must be taken into account. There is reason to hope, however, that by carrying the process of abstraction through level after level of definition (i.e., abstracting definitions of definitions) one will eventually

approximate a set of atomic components, what might be called the "basic English of definition." It is at this point then that the specificity of a word could be measured by counting the number of atomic components needed for its definition. This work on componential specificity is not finished yet, but continues to be carried out in increasing detail and sophistication by Miss Williams.

There are two advantages to the concept of componential specificity. The first is that by going beyond taxonomy it can be used to provide a measure according to which <u>all</u> words are comparable with respect to specificity. For instance it makes the specificity of <u>slide rule</u> less than, equal to, or greater than that of <u>eternity</u>. This may be somehwat unintuitive, but it is at least as acceptable as the "atomization of meaning" and the semantic tradition to which it belongs. The second advantage is that,when one approaches specificity in this way,use is made of a great body of scholarly research on meaning, <u>viz</u>., the dictionary. Such an approach is firmly objective about meaning and meaning relationships in natural language, more objective, say, than that seen in the quick, expedient and often ad hoc construction of special purpose thesauri.

vi. So far it has been seen that the ambiguity of specificity is diminished when it is understood in terms of a strict inclusion relation, "strict" in the sense of the relation having a limited and well-defined domain, either in mathematical or ordinary language, or when each of the special cases of the specificity relation is enumerated in the form of an authority list or a thesaurus which is more or less sanctioned by ordinary language. Another

approach to finding some common denominator in specificity-viewpoints is to study directly the common usage of language, in particular what might be called the "sociology of classification." Appropriate to such a study are socio-linguistic experimental methods, especially those making use of questionnaires. The objective would be to discover and measure the amount of consistency to be found in different people's opinions about specificity. An experiment might be designed, for instance, wherein people are asked to order words on the basis of their intuition or immediate perception of specificity. The results could be expected to indicate how regular the specificity relation is from the point of view of shared language behavior. A possible difficulty with such an experiment is that there are many instances where common sense would balk at having to make a decision about a relationship; for instance, shoe and eternity might naturally be regarded as being outside the proper domain of a specificity relation, i.e., as being incomparable. To force an ordering where none seems immediately apparent could result in some fairly arbitrary classification patterns, with little chance of overlap. On the other hand an experiment need not be so blunt, and more subtle studies of language behavior using questionnaires would be useful in bounding the domain where there is consensus as to the "correct" use of the specificity relation.

vii. A seventh type of specificity is one which seems particularly applicable to language as it is used in indexing the collection of books or documents in a library. This specificity has been referred to on the GLS Indexing Project as "operational spec-

ificity or simply, "breadth." The term "operational" is used to distinguish this type of specificity from any of the preceding types, which may be loosely referred to as "semantic" specificity. The operational specificity or breadth of an index term or subject heading is defined as the number of items in the collection indexed by the term, that is, the number of postings made to the term. The average breadth of indexing for a given collection is the number of documents indexed by an "average" term, or the total number of term postings divided by the number of terms in the vocabulary used to do the indexing. In other words, the breadth of a term is its frequency of occurrence. Average breadth is average frequency of occurrence.

There are several points to be noted about this definition of breadth. The first is that the definition is an extensional one, the extension in question being an extension of a particular and very definite kind. As was indicated earlier the extension of a word in ordinary language is its denotation, or the range of objects to which the word may be applied. Analogously the extension of an index term may be considered to be the books in a collection to which the term is assigned. There is some precedence in the literature of indexing for regarding an index term as denoting a class of documents:

> The index term 'Newfoundland' refers, therefore, to the class of <u>documents</u> in which the individual entity 'Newfoundland' is discussed. That such a class (or group) of documents exists is indisputable. That the further use of the index term 'Fauna' would serve to describe another class of <u>documents</u> is equally true, and the conjoint of the

> two would designate a possible class of documents in which the fauna of Newfoundland were discussed, even though no example of the class were immediately available in the collection.[1]

A class of documents or books is the referent of an index term, it is what is "indicated" by the indicating function of the term, and it is what is retrieved by the term in an information retrieval operation.. . . in short, it is an extensional or operational meaning of the term. Within a given collection the number of items in such a class can be counted, and thus one is provided with methods for obtaining the quantification necessary for a theoretical or empirical study of the effect of breadth (specificity) of term on retrieval performance.[2]

The definition of operational breadth makes use of statistics -- the statistics of an indexed collection of documents -- rather than semantics. As was just seen, however, there is an analogy between at least one kind of semantic meaning, viz., de-

---

[1] Center for Documentation and Communication Research, School of Library Science, Western Reserve University, "Comments on 'A Logician's Reactions'," American Documentation, VIII (April 1957), pp. 120-121.

[2] Breadth or operational specificity as it has been defined is understood to be a property of an index term, viz., the number of documents to which the term is assigned. One can also speak of a relation of operational specificity. A strict interpretation of the relation would be to regard it simply as the inclusion relation holding between classes whose members are books. Thus if all books indexed by fluid mechanics are also indexed by mechanics, then fluid mechanics is in specificity less than or equal to mechanics. The inclusion relation is the strict one discussed earlier. having the properties of transitivity, reflexivity and antisymmetry. A weaker interpretation of the relation of operational specificity can be obtained by relaxing the condition of antisymmetry which makes it possible then to say that one term is less specific than another if it indexes fewer books. The weaker interpretation has the advantage that all terms become comparable with respect to specificity.

notative or extensional meaning, and the meaning of an index term when it is regarded as referring to a class of books. But it is an analogy only, and must be regarded as such. The difference is that in one case the objects denoted by words are things in the real world, in the other, books in a library collection. It is perhaps interesting to ask how far the analogy can be pushed, how much correlation there is between operational and semantic (extensional) breadth. One of the objections that can be advanced against the definition of operational specificity is that it is counterintuitive in the sense that if in one library there are 10 books indexed by Dog and only five by Mammal, then mammal is more specific than dog. The specific entry principle precludes the use of a suitable broad term when another suitable but more specific term might better describe a book. This has the effect -- desired -- of facilitating searching and retrieval by preventing too many entries from accumulating under any one subject heading. And it can quite easily happen that there are fewer entries under Mammal than under Dog. This example would suggest that there is, in fact, no correlation at all between semantic and operational breadth. It can be argued, however, that a correlation can be seen if one takes into account implicit entries in the catalog. That is, if all books on dogs were counted as though they were indexed under Mammals, then there would be ten books on dogs and fifteen on mammals -- and the semantics would be straight. The semantic-operational breadth correlation can be superimposed in a more formal way by introducing a thesaurus together with a rule which says

that if a book is indexed by a semantically specific term it is automatically regarded as being indexed by any more inclusive term. According to this rule the class of books on dogs would be regarded as being included in the class of books on mammals. A retrieval search is broadened by replacing the search term Dog by the term Mammal. The semantic breadth of the search term is increased here; within any given collection, there must be, quite automatically, a corresponding increase in operational breadth, so long as the collection contains some books on mammals that are not also dogs. Artfully then, a correlation can be established between semantic and operational breadth.

Though it is true there is some correlation between semantic and operational breadth, it is important to be aware of the differences, as these are important in understanding the operation of an indexing system or a library classification. The question of correlation is a particular formulation of a wider question about the relationship of an indexing language to language in general. An earlier approach to this question was to distinguish between natural and artificial classification,[1] and then to ask: does a library classification reflect the structure of knowledge (information) -- and perhaps in so doing describe a natural order of things; or is the ordering simply a convenient and somewhat arbitrary ordering of books? The distinction here is between bibliothecal and scientific classification, between words being used to

[1]See W.C. Berwick Sayers, A Manual of Classification for Librarians and Bibliographers, 2nd ed. (London: Grafton, 1944), esp. Chaps. II and IX.

indicate classes of entities, and words used to indicate classes of books. Superficially the language that orders books looks to be the same as the language that orders the world. But it is impossible to imagine a complete isomorphism between books and things. The same language used for two different purposes is not exactly the same. A word used as an index term or a subject heading is not the same as itself when it is used to describe something in the world. In Wittgenstein's terminology, the one word belongs to two different "language games," and between these two games there are similarities as well as differences. And between semantic and operational breadth there is and there is not a correlation.

A seeming disadvantage of the definition of operational specificity is that it makes the breadth of any term relative to a particular collection of documents. It can happen, for instance, that a given term is broad in one collection and quite narrow or specific in another, depending upon the nature of the collection and the public for whom it is indexed.[1] But it can be argued that a definition that allows breadth to be relative is in fact quite accommodating in that it reflects a fairly accurate picture of just what is the case. Different libraries find it expedient to operate at different levels of specificity. It is generally assumed[2] that the larger the library the more specific must be

[1]See the reference from Sears, cited earlier, p. 34. And Lilley writes: ". . . if the same book is described satisfactorily at different levels of specificity depending on the library collection to which it belongs, it can be said that 'specificity is in part a function of a particular library'." (Lilley, "How Specific Is 'Specific'?" p. 5).

[2]See for instance Pettee, Subject Headings: The History and Theory of the Alphabetical Subject Approach to Books.

the subject headings it uses. One library, for instance, may have 1000 books in its collection appropriately headed Printing, while another may have only 10 books on this subject. For ease of reference the first library may choose to subdivide its books on printing, for instance into geographic categories, Printing-U.S., Printing-France, etc. Ease of reference would not require this in the second library. The relativity of specificity perhaps loses some of its disturbing quality if the question "How specific is specific?" reads "How precise is precise?" For one rather expects precision to be relative. At least the rejoinder "precise enough for what?" seems acceptable. In the context of assigning headings to books in a collection, the question "specific (precise) enough for what?" can be answered, "specific enough for easy reference." It seems important to distinguish between questions about the meaning of "specificity" (how is the specificity relation understood) and the question: how specific (precise) must a description be to be useful for some purpose, for instance for indexing a book in a particular library? It is the latter question which most properly engenders comments about the relativity of specificity, since there is no single description which from a global point of view is correctly specific, there are rather many different descriptions made to suit different purposes or requirements. It is in a context such as this that a definition of operational specificity is useful. Operational specificity is decidedly relative, but it is clearly and unambiguously so. Its relativity reflects the very legitimate variability not of "specific," but of "appropriately

specific, specific enough for some purpose."

Finally the definition of operational specificity makes explicit a concept of specificity used in natural language, in particular "specificity" as it is used in the application of the specific entry principle. As was seen[1] an important function of the specific entry principle is to insure that not too many entries accumulate under any one heading, a situation that would make searching tedious, that would detract from "easy reference." With observation that it is also possible to err in the other direction and to have too much specificity with too few entries under one heading, the intent of the specific entry principle is clarified in a sign'ficant way. It can be argued that it was never intended to mean "be as specific as possible," the intent was rather to be relatively specific, to "be only as specific as necessary." Pettee's remark might be repeated here:

> As the choice between the most specific term (which can be used as a heading) and a more inclusive one depends entirely upon the number of items which will be likely to collect under the more inclusive terms, a safe rule would be to prefer the more inclusive for less than a dozen titles.[2]

In other words, the operative factor in determining the specificity necessary is the number of items posted to a given heading, *viz.*, the operational breadth of the heading.

---

[1] See pp. 20, 21 and 22.

[2] See p. 22.

Summary

Wittgenstein writes that "philosophy is a battle against the bewitchment of our intelligence by means of language."[1] As a method of approach, the philosophical one seems appropriate in dealing with the confusion which has centered around the concept of specificity, a concept of special importance in the theory of indexing. The method demands the making of distinctions. The question which begins this paper is "How specific is specific?" -- a somewhat vague question, and largely rhetorical, intended only to underscore the fact that "specificity" is viewpoint dependent. Though the concept of specificity may have vague boundaries, there is a large area in the center which is not vague -- that is, there are many particular cases where there can be no viewpoint-generated misunderstanding at all as to its meaning. A simple illustration of this is to observe that the following classification can be funny:

> In this text, Borges quotes 'a certain Chinese encyclopedia where it is written that "Animals are divided into a) belong to the Emperor, b) embalmed, c) tamed, d) suckling pigs, e) sirens, f) fabulous, g) dogs at liberty, h) included in the present classification, i) which act like madmen, j) innumerable, k) drawn with a very fine camels hair brush, l) et cetera, m) which have just broken jugs, n) which from afar look like flies'".[2]

The main thrust of the present chapter has been to consider what common ground there is for understanding the concept of spec-

---

[1]Wittgenstein, Philosophical Investigations, p. 47.

[2]Quoted by Richard Poirer, "The Politics of Self Parody," Partisan Review, XXXV (Summer 1968), 352.

ificity. Seven different types of specificity or specificity relations on which one might expect to find some agreement were discussed. They are, in summary:

1) Formal Specificity: Specificity can be defined in terms of the logical relation of class inclusion. One class A is more specific than another class B if and only if A is properly included in B. Formal specificity is an abstract concept and is divorced from the "meanings" of ordinary colloquial language. Much of the apparent relativity of semantic specificity can be understood as resulting when formal specificity is extended in imperfect and irregular form beyond its legitimate domain to the whole of language.

2) Extensional Specificity: In ordinary language the specificity relation (regarded as inclusion) is used with logical precision when it holds between classes that can be clearly defined in extensional terms. There specificity is not relative; no one would disagree that cat is more specific than mammal, but there would be little agreement that beautiful is more specific than good.

3) Phrase Length Specificity: One extension of the inclusion relation into the domain of nonreferential language seems fairly unambiguous. This is when specification is regarded as modifying. There are exceptions, but generally it holds that a word modified is more specific

than a word unmodified. Red house is more specific than house.

4) Coercive Specificity: The specificity relation can be defined more or less well by enumerating all the pairs of objects (words) between which the relation is supposed to hold. In effect this is what is accomplished by the construction of thesauri, classification schedules and authority lists. There can be no disagreement in practice about the relative specificity of two subject headings; it is simply a matter of consulting an authority list to see whether a specificity relation holds between them, in one direction, in both or not at all.

5) Componential Specificity: A quantitative measure of specificity has been developed by Thyllis Williams. Roughly the specificity of a word is proportional to the complexity of its dictionary definition, where definition complexity is understood in terms of both the descriptive components and the syntax of the definition.

6) Consensus Specificity: Presumably there exists some partial consistency in different people's opinions about specificity, a consensus whose bounds are unknown but might be measurable using socio-linguistic experimental methods.

7) Operational Specificity: Operational specificity is de-

fined in the context of indexing, or assigning subject headings to, books in a library. The operational specificity of an index term is the number of books in the collection indexed by the term. The definition is an extensional one, in that the "meaning" of an index term is regarded as its extension, viz., the class of books to which the term is assigned. Operational specificity is decidedly relative, but it is so in a clear, mathematically measurable way. Its relativity reflects the very legitimate variability not of "specific," but of "specific (precise) enough for some purpose." Further, the definition of operational specificity goes some way to make explicit the concept of specificity as it is understood in the application of the specific entry principle. It does this insofar as the function of the principle is to regulate the number of entries that accumulate under any one heading. In the discussion of the uses of the specific entry principle it was shown that if this is not the main function of the principle, it is at least an important one. Since the operational specificity of an indexing can be measured and since, as will be seen (p. 58), there is a method for systematically varying the operational specificity of indexing, this definition is the one chosen for use in the present experimental study of the effect of specificity on indexing effectiveness.

CHAPTER II

EXPERIMENTAL DESIGN

Introduction

The question, "What is good indexing?" is vague and unclear. It may be that in the long run a question like this cannot be answered in any simple way, yet it is one which has led to much speculation. Perhaps rather necessary speculation, since the belief that some index terms are better chosen than others is the *raison d'etre* of indexing practice so far as it is not wantonly haphazard but based on indexing principles and authority lists. It has not been until recently that speculation has given way to more objective criteria for evaluating different methods of indexing. Notable in the early attempts at such evaluation is the first Cranfield project (1960)[1] which, under the supervision of Cyril Cleverdon, carried out experiments to test the comparative performance of four indexing systems. Systems performance was measured in terms of the amount of relevant and irrelevant material retrieved in response to search requests addressed to an indexed collection of documents. The importance of the experi-

---

[1]Cyril W. Cleverdon, *Report on the Testing and Analysis of an Investigation into the Comparative Efficiency of Indexing Systems* (Cranfield, England: College of Aeronautics, ASLIB Cranfield Research Project, October 1962).

ment derives from its being the first large scale effort to use objective criteria for determining the relative "goodness" of different indexing methods, suggesting thus that there may in fact be a rational way to choose from among different systems and their conflicting claims.

Since 1960 further experiments, rather more scientific in nature, have been carried out, and other more subtle measures for evaluation have been proposed. At the same time, perhaps as a lesson learned by hindsight from mistakes made in the early Cranfield experiment, there has been a tendency away from the wholesale comparison of different indexing systems towards the singling out of certain individual factors involved in the indexing process and seeing how variation in these affects retrieval performance. Here again the work of Mr. Cleverdon is notable, this time in the Cranfield II project, an experimental study of factors determining the performance of indexing systems.[1] Indexing depth, the number of index terms assigned to a document, is one of the factors affecting retrieval performance. This factor is studied from a theoretical point of view by Swanson in

---

[1]The report of the Cranfield II project is contained in the following publications:

Cyril W. Cleverdon, J. Mills and M. Keen, Factors Determining the Performance of Indexing Systems, Vol. 1 -- Design: Part 1 -- Text, Part 2 -- Appendices (Cranfield,England: College of Aeronautics, ASLIB Cranfield Research Project, 1966).

Cyril W. Cleverdon and M. Keen, Factors Determining the Performance of Indexing Systems, Vol. 2 -- Test Results (Cranfield, England: College of Aeronautics, ASLIB Cranfield Research Project, 1966).

"On Indexing Depth and Retrieval Effectiveness."[1] A model of an indexing system is developed which makes it possible to predict the effects on recall and precision when indexing depth is varied by randomly deleting index terms from documents.

Specificity of indexing can also be regarded as a factor that affects retrieval performance. The definition of operational specificity developed in the last chapter makes experimental testing possible, and, as was suggested, this definition at least approximates the meaning of "specificity" as it is implied in the usage of the specific entry principle. And indeed the main objective of the present study is to test the effect on retrieval performance of indexing specificity so defined.

An objection to attempting to find the goodness of an index term in the measure of its operational specificity of breadth, which is a statistical property of a particular indexed collection of documents, is that this takes no account of the relation an index term bears to what it indexes. It seems natural to regard a good index term as one that telescopes sharply the central concepts in the work being indexed, one that in some way is semantically appropriate. The semantic appropriateness of an index term is difficult enough to comprehend let alone evaluate. Intuition, of course, is a method that can be used to determine which index terms best describe the content of the works being

[1]Don R. Swanson, "On Indexing Depth and Retrieval Effectiveness,"Proceedings of the Second Congress on the Information Systems Sciences, Hot Springs, Virginia, November 1965, pp. 311-319.

indexed. In some indexing practices this intuition is exploited and terms are weighted according to their felt importance to the text. Another method of delimiting semantically appropriate index terms is to assume that certain words, by virtue of their location in positions of importance in the work being indexed, are more semantically descriptive than others and are, thus, the most suitable candidates for index terms. As was seen in the preceding chapter, since the middle of the 19th century the title of a work has traditionally been pointed to as the position of prime importance. A secondary objective of the study is to test the hypothesis that the quality of index terms assigned to documents, rather than their specificity, is the operative factor in retrieval effectiveness.

Overview of the Experiment

The Salton-Cranfield data, a subset of the Cranfield II data, has been borrowed for use in the experiment to be described.[1] It consists of 200 documents, mainly in the field of aerodynamics, and 42 search questions to which the documents in the collection have been judged, by subject experts, as relevant or irrelevant. The documents have been manually indexed by trained indexers to a considerable depth, on the average 34.5 terms per document. What recommends this data for the experiment, besides its availability,

[1] The report of Salton's experiments with the subset of the Cranfield II data is given in: Gerard Salton, "Computer Evaluation of Indexing and Text Processing," Journal of the Association for Computing Machinery, XV (January 1968), 8.

is that it is the only data where the relevance judgments have been made by subject experts and where an indexing of this depth has been done manually by trained personnel.

The general testing procedure is the following. The indexing of the documents is systematically varied by deleting certain of the index terms. For instance in one operation broad terms are deleted from documents; in another, narrower terms are deleted; index terms are deleted from a document if they do not also occur in the title of the document; or terms which are not heavily weighted, i.e., not thought especially important by the indexer, are deleted. At each deletion, a subset of the terms originally assigned to the documents in the collection is removed, the purpose being to see if this change in the indexing makes a significant difference in retrieval performance. Thus the "importance" of different sets of terms, broad terms, non-title terms, etc., is judged by the effect of their absence from the indexing of the documents.

After each deletion, the 200-document collection is searched in order to retrieve documents responding to the search questions that are addressed to the collection. The searching procedure is of the usual type where terms used to index the question are "matched" with the terms used to index the documents in the collection. The output of the searching is then evaluated according to different measures of retrieval effectiveness. In this experiment, the familiar precision and recall measures are used, as well as the Expected Search Length (esl) measure developed by

Cooper.[1] The testing procedure then, is to delete index terms, to retrieve documents in response to search questions and to evaluate the precision-recall and esl effectiveness of the altered indexing. Each time these operations are performed, the question is asked whether the esl, precision and recall values obtained using the altered indexing differ significantly from those yielded by the original indexing, before any terms were deleted. The statistical test used to assess the relative effectiveness of the before-and-after deletion indexing is the Wilcoxen Test. Most of the experiment is programmed in PL1; Fortran is used for the Wilcoxen Test. The remainder of this chapter discusses in detail the variables in the experiment, the deletion procedures, the measures of retrieval effectiveness, the Wilcoxen statistical test, the Salton-Cranfield data, and the programming strategy used in the experiment.

The Variables

1) Operational specificity or breadth (B): This has already been defined in Chapter 1. The operational breadth of a term is the number of documents, in a given collection, which the term is used to index. Average breadth $(\bar{B})$[2] is the number

---

[1]William Coooer, "Expected Search Length: A Single Measure of Retrieval Effectiveness Based on the Weak Ordering Action of Retrieval Systems," American Documentation, XIX (January 1968),30.

[2]Average breadth is a property of an indexed collection of documents; thus, one can speak of the "average breadth of indexing" or of "average indexing breadth." As it seems unlikely that ambiguity can result, the modifier "average" is sometimes

of documents indexed by an "average term," or the total number of term postings divided by the number of terms on the vocabulary list from which the index terms are selected.

2) Depth (D)[1]: This variable will be defined here in the same sense as that used by Swanson in the paper "On Indexing Depth and Retrieval Effectiveness."[2] Indexing depth is the num-

---

omitted: by "indexing breadth" and "breadth of indexing" is meant average indexing breadth and average breadth of indexing. The word average is also omitted in similar expressions of indexing depth.

[1]The term "exhaustivity" is common in the information retrieval literature but is avoided here. Exhaustivity is a measure of the extent to which all the distinct "concepts" discussed in a particular document are recognized in the indexing operation. It is opposed to specificity which is the generic level at which a concept is recognized in the indexing. Conceptual analysis is philosophically a bug-bear. The trouble with concepts is that they are not always clear and distinct; especially in the less hardcore sciences and humanities this is true. Moreover, thesauric relationships between concepts are often ad hoc, subject to point of view, even illogical (eg., Fairthorne's example from U.D.C. where slide rules are specific to apparatus with wheel mechanisms). Occam's razor might be taken to the distinction between exhaustivity of indexing and specificity of indexing, on the grounds that operationally the distinction is not real but exists by definition. Both specificity and exhaustivity can be reduced by moving to a broader class; in the one case by moving up in a thesaurus hierarchy, in the other by moving to a lower cutoff point. However, depending on how "index term" is defined, a move say from "finite wings" to "wings" could be interpreted either as a move in hierarchy or exhaustivity ("finite" and "wings" could be two index terms, or "finite wings" could be one). Indexing and searching are not independent operations. In the literature one sees attempts to separately evaluate these two operations, glossing over possible interdependencies. It can be argued that the difficulties arise owing to a terminology that is not clearly explicated.

[2]Swanson, "On Indexing Depth and Retrieval Effectiveness."

ber of index terms assigned to a document. Average depth ($\bar{D}$) for an indexed collection of documents is the average number of terms assigned to a document, or the total number of term postings divided by the number of documents in the collection.

3) Collection Size (N): This is simply the total number of documents in the collection. In the present experiment N is regarded as a constant.

4) Vocabulary Size (V): It is assumed that in the indexing of documents terms were assigned from a controlled vocabulary or authority list of allowed possible terms.[1] Vocabulary size is then defined as the number of terms on this vocabulary list. This number is a constant throughout the present experiment.[2]

---

[1] The actual indexing at Cranfield was not in fact constrained by any sort of vocabulary list. The purpose of the Cranfield II project was to see how retrieval performance is affected by introducing increasingly greater measures of control into the simplest form of indexing, viz., selecting words directly from the natural language of the document being indexed. The purpose of the present experiment, however, is to test the effect on performance of varying the operational breadth of indexing; for this it is necessary to have a precise definition of vocabulary size. It is necessary, in other words, to assume some sort of initial indexing vocabulary or authority list. It seems the simplest way to do this is to regard the full set of terms used to index the original Cranfield II collection as constituting a hypoethetical vocabulary list for the 200 documents in the Salton-Cranfield subset of the collection.

[2] It can be observed that some of the terms on the hypothetical vocabulary list are never actually used in indexing the 200-document subset collection; consequently these terms have breadth 0. It is perhaps aesthetically awkward to allow for null postings, i.e., index terms of breadth 0, and one might contrive to get rid of them by restricting the indexing vocabulary to those terms which are used at least once in indexing the 200 documents. On the other hand it can be said that any definition of vocabulary size that is based on the frequency of term occurrences entails some arbitrariness in cutoff -- should one presume, for

The above variables are related to each other by the following formula: $\bar{B}V = \bar{D}N = T$[1], where T is the total posting frequency. This formula prescribes the experimental method for varying breadth of indexing. Since V and N are constants, if the average depth of indexing is decreased, i.e., if certain index terms are removed from documents, this will automatically decrease the breadth of the terms removed, and, thus, average breadth is also decreased. The method of varying indexing breadth then is simply to vary the depth of indexing by deleting terms from documents.[2]

---

instance that breadth 0 is significantly different from breadth 1, but that there is no significant difference between breadth 1 and 2? There seems reason enough for defining indexing vocabulary independently of the index terms actually posted, that is, in terms of an assumed pre-established vocabulary list.

[1]T (total number of postings) can be expressed in several ways:

1) $T = N\bar{D}$
2) $T = V\bar{B}$
3) $T = \sum_{i=1}^{V} \sum_{j=1}^{n} t_{ij}$ i.e., the sum over the document-term matrix. i ranges over the V vocabulary terms; j ranges over the N documents.
4) $T = \sum_{B=0}^{z} B n_B$ where B (breadth) ranges over the z different breadths and n_B is the number of terms of breadth B.

[2]See E. Svenonius, "The Effect of Breadth of Term on Retrieval Performance," Studies in Indexing Depth and Retrieval Effectiveness (NSF GN 380) (Chicago: University of Chicago, Graduate Library School, 1968).

Swanson, in his paper "On Indexing Depth and Retrieval Effectiveness,"[1] examines the effect on precision and recall when the average depth of indexing is decreased in a particular way, <u>viz</u>., by deleting index terms from documents randomly. He finds that recall drops but precision tends to improve[2] when terms are randomly deleted from documents. From only theoretical consider-

---

[1] Swanson, "On Indexing Depth and Retrieval Effectiveness."

[2] Precision does not always increase when terms are randomly deleted from documents. For instance, on the case where the retrieval condition is set at the highest cutoff point possible. In this case no documents can filter down into this overlap category and precision after deletion is the same as it was before. Mathematically,

where N^q_{ipk} is the number of documents, each with p index terms, which contain k index terms in common with those of a question q. i = 0 refers to irrelevant documents with respect to q; i = 1 refers to relevant documents with respect to q.

d_{1pkt} is the percentage of documents with k overlaps that lost t after deletion

and L is the ratio of relevant to irrelevant documents retrieved

P is indexing depth

m is number of terms deleted (See Swanson, "On Indexing Depth and Retrieval Effectiveness.")

Since $d_{1pk0} = d_{0pk0}$,

$$\frac{L_{p-m}}{L_p} = \frac{d_{1pk0} N^q_{1pk}}{N^q_{1pk}} \times \frac{N^q_{0pk}}{d_{0pk0} N^q_{opk}} = 1$$

Thus $L_{p-m} = 1 \times L_p$, there is no change in L and consequently none in precision (precision = $\frac{1}{1 + \frac{1}{L}}$).

ations then, one can obtain at least a conditional answer to the question: how does the average breadth of indexing affect retrieval effectiveness? The answer is that recall drops and precision tends to improve in proportion as the average breadth of indexing is decreased. The condition is that indexing breadth is varied by a random deletion method. Note that if consideration went no further, the notion of average breadth would be superfluous, since average breadth is a linear function of average depth and anything which can be said of one of these parameters in its relationship to retrieval effectiveness can derivatively be said of the other.

On the other hand, randomly deleting index terms from documents is only one method of varying the average breadth of indexing. It can be asked what happens to retrieval performance when terms other than "the important ones" are deleted. One might characterize unimportant or peripheral index terms to be deleted as those not occurring in the title of the document, or as terms which are not highly weighted, or, in the case of broad and narrow terms, leave judgment suspended and the question open to investigation. Restricting the method of varying the depth and breadth parameters to a random deletion process is a simplifying measure convenient as a first step in a theoretical approach to the question.[1] In an experimental situation, how-

[1]In W.B. Rayward and E. Svenonius, "Consistency, Consensus Sets and Random Deletion," Studies in Indexing Depth and Retrieval Effectiveness (NSF GN 380) (Chicago: University of Chicago, Graduate Library School, 1967), an attempt was made to study the non-

ever, a restriction of this sort is not necessary -- it is relatively simple to study the effects on retrieval performance of deleting terms from documents by a systematic nonrandom method. This is what is done in the present experiment; broad, narrow, non-title terms, terms not heavily weighted,are deleted from the indexing of the documents. The concern is not so much with the effects on retrieval of varying the average breadth (equivalently: average depth) of indexing, as with the effects of removing particular classes of terms, those designated as broad, narrow, etc. Average depth and breadth are in a sense extraneous variables; they are therefore held constant under deletion. Whether the terms deleted from documents are broad or narrow, it is always the same number of terms that are deleted.[1] Thus, while different indexings result from the deletion of broad and the deletion of narrow terms, they represent indexings of the same average breadth, average depth and total posting frequency. Although the main

---

random deletion of index terms theoretically. The question asked was what happens to retrieval performance when unimportant terms are randomly deleted from documents. (In the study no attempt was made to characterize important and unimportant terms.) The difficulty with such an approach is that the deletion model becomes subject to even more simplifying assumptions, thus paling further its ability to depict a real situation; at the same time the model becomes so complex and heady it needs more to be explained than it could explain.

[1]Average breadth is diminished equally whether a broad <u>resp</u>. narrow term is deleted from a document, or whether a term is randomly deleted. This is because in each case the total number of postings is altered equally; V and N are constants. (If any k terms from the vocabulary list are deleted from documents, average breadth after deletion is $\frac{T - k}{V}$.)

objective of the experiment is to compare the relative usefulness of broad and narrow terms, it can be said that what, in effect, is being compared are different nonrandom deletion methods. From this point of view the experiment can be regarded as contributing to an understanding of the effect of indexing depth on retrieval performance in that it extends the means of varying depth beyond the random deletion method.

Deletion Procedures

The experiment was conveniently divided into two stages, corresponding to two questions the experiment was designed to answer:

1) Of the index terms assigned to documents,which function most effectively in retrieval, the most used or popular terms, or those which are used relatively infrequently?

2) Do two indexings of comparable average breadth (or depth) differ significantly in the retrieval results they produce because one consists of "quality" indexing and the other does not?

Stage 1: In comparing the effectiveness of broad vs. narrow terms, terms of varying degrees of breadth were deleted from the documents. The first step in classifying terms as "broad" or "narrow" was to obtain the spread of different breadths by listing the vocabulary items in order of their frequency of occurrence, i.e., according to how many times they were used to index documents. The question was how to decide exactly which of the terms should be called "broad" and which "narrow." It was decided that instead

of drawing a single line between "broad" and "narrow," more information would be gained if varying degrees of breadth were allowed. The decision was to have four categories of terms: broad terms (those posted most frequently), relatively broad terms, relatively narrow terms, and narrow terms (those posted least frequently). These four sets or quartiles of terms were obtained in the following manner: the total number of term postings to documents was divided by four (T/4). Then beginning at the top of the frequency list of vocabulary terms, i.e. beginning with the most frequent terms, and going down this list, the frequencies of the individual terms were summed until the number T/4 was reached. All terms whose frequencies were summed were said to belong to the first quartile of terms; these consisted of the broadest terms used in the indexing. Continuing down the list, summing frequencies again equal to T/4 gave the second quartile of terms, and so on, for the third and fourth quartile terms. Each of the term quartiles thus obtained represents a subset of the original indexing of the documents, the first quartile consisting of the broadest terms, the second of the next broadest, etc. What these sets of terms have in common, and why they are called "quartiles," is that the total number of postings represented by the terms in each of the quartiles is the same, approximately T/4,[1] or one quarter of the total term postings. A consequence is that

[1]"Approximately," because it was desired that every occurrence of a given term be in one quartile, i.e., that terms not be "split" with some of their postings in one quartile and some in another; this required making quartiles with slightly less or slightly more than T/4 postings. See note 2, chap. III, p. 93.

there are many fewer unique terms in the first quartile, consisting of broad terms frequently posted, than in the fourth quartile, consisting of infrequently posted terms.

There were four deletions of terms from documents corresponding to the four term quartiles. In the first deletion those terms occurring in the first quartile were deleted, the deletion of a term being understood to mean its removal from each of the documents to which it was originally assigned. The retrieval operation was performed and the results evaluated. These first quartile terms were then restored to the documents from which they were taken, and then second quartile terms were removed. And so on. The breadth of an individual term determined whether or not it was deleted, and each of the terms used to index the documents was deleted in one and only one quartile deletion. At each deletion the same number of postings were removed from documents. The rationale for this was to achieve, after each deletion, indexings having the same average depth, average breadth and total posting frequency, the variable of interest being not these general statistics but the breadth of terms deleted. (See p. 62.)

Stage 2: In order to determine whether title terms and heavily weighted terms are especially suited to be index terms, the retrieval power of these terms had to be tested with respect to a comparable set of other "reasonable" index terms. It was assumed that a reasonable index term would be any of those assigned to a document in the original Cranfield indexing. Accordingly the following four deletions were made from the indexing of the docu-

ments:

1. From each document, all index terms not also occurring in the title of that document were deleted.

2. The same number of terms was randomly deleted[1] from the indexing of that document.

3. From each document, all index terms that were not given the heaviest of weightings (weight 10) were deleted.

4. The same number of terms was randomly deleted from the indexing of the document.

Deleting in this manner permitted the testing of two indexings that represented two subsets of the originally assigned terms, subsets of equal size but one consisting of "quality" terms and the other of merely "reasonable" terms.

Evaluation of Retrieval

After each of the deletions of index terms from documents, the collection was scanned to retrieve documents responding to the search requests. In the searching procedure, terms used to index the questions were matched with terms used to index the documents. Though there have been various sophisticated matching functions defined in the literature, the one used in the present experiment was a relatively simple one, *viz.*, only exact (machine-like)

[1]Note that "random indexing" is used to mean a random sample of the index terms that were assigned to the documents in their first indexing. That is, the terms are not just any haphazard terms, but are, rather, assumed to have some relevance to the documents they index, in as much as they were put on the documents by trained indexers. In the present experiment then, random indexing is a random sample of index terms previously judged as suitable.

matches were permitted.[1] The usual definitions of "retrieved," "precision," and "recall" were used. A document is considered "retrieved" if the number of overlaps or matching document-question terms is equal to or greater than a certain specified number, called the cutoff point. Precision and recall are then defined with respect to the relevant documents that are retrieved, and precision is the proportion of retrieved documents that are relevant.

The Expected Search Length measure was also used to evaluate retrieval performance. This measure assesses the effectiveness of a retrieval system in retrieving a specified number of wanted relevant documents (s*). The measure assumes that for each search question or request the collection of documents is partitioned into n sets or levels of documents which have, respectively, n, n-1, n-2 . . . terms in common with the question, the highest or top level of the ordering consisting of those documents which have n terms overlapping search request terms. The collection is searched for relevant documents beginning at the top level of the ordering and proceeding down through the lower levels until the requisite number of relevant documents is found. The "Expected Search Length" (esl) is a measure, a statistical expectation, of the number of irrelevant documents that must be gone through before the request is satisfied. Thus esl values increase as the system performs less effectively. The formal definition of esl is as follows:

---

[1]The choice of matching function is somewhat dependent on how "index term" is defined. See footnote on p. 79.

$$\text{esl } (q) = j + \frac{is}{r + 1}$$

where q is the request for which esl is being determined

j = the number of irrelevant documents found at levels preceding the level where the request is satisfied

i = the number of irrelevant documents at this level

r = the number of relevant documents at this level

s = the number of relevant documents at this level required to satisfy the request

There is a rough correspondence between esl and the precision-recall measure. In a search through a collection of documents partitioned according to overlap, a request for a single document ($s^* = 1$) is generally satisfied at a high overlap level. Thus setting the retrieval condition at a high cutoff level can be regarded as analogous to making a request for a single or few documents. On the other hand, if many documents are requested of the system (for instance all relevant documents), it is not likely that the request can be satisfied at a high overlap level. In fact, if all relevant documents were wanted and it happened that one of these had no terms at all in common with the question, the search for this document would have to proceed down from the highest overlap level through all the succeeding levels until the document was eventually found at the 0 overlap level. Often setting the retrieval condition at a low cutoff level is analogous to making a request for many documents. A low s* value can be interpreted to mean the user is more interested in precision than recall, a high s* value can mean recall is preferred to precision.

The Statistical Test

The Wilcoxen matched-pairs signed-ranks test[1] was used to determine whether the esl, precision and recall values obtained after the deletion of terms were significantly different from the corresponding values before deletion. Also compared for significance were different indexings of the same depth: indexing with title terms *vs*. indexing with the same number of terms chosen randomly from the original indexing; indexing with heavily weighted terms *vs*. a random selection of the original terms to a like depth.

The Wilcoxen Test is a nonparametric test. That is, it is not conditional upon assumptions regarding the nature of the population from which the sample is drawn -- it need not be assumed, for example, that the sample values are drawn from a normally distributed population. There are advantages and disadvantages to nonparametric tests, the main advantage being, of course, that they are "distribution-free." The relaxing of conditions contributes to the main disadvantage of the tests, *viz*., they are not as powerful as the corresponding parametric tests when the conditions needed for the parametric model are satisfied. In the present experiment making any assumptions about the population distribution would be unrealistic and there was really no option in deciding between a parametric or a nonparametric model; the nonparametric one had to be used. Since the differences that were being judged for significance were between two related samples (eg., the precision

---

[1] For a more extended description of the test than is given here see Sidney Siegel, *Nonparametric Statistics for the Behavioral Sciences* (New York: McGraw-Hill, 1956).

values yielded by two different indexing methods), and since the values being compared represented ordinal measurements, either of two nonparametric tests could have been used: the sign test or the Wilcoxen Test. The tests are rather similar and either would indicate whether one indexing method is significantly better than another. The Wilcoxen Test, however, has an advantage over the sign test in that it can be used to tell not only that one indexing method is better than another, but also how much better. Exploiting information about the magnitude as well as the direction of the observed differences, the Wilcoxen Test is thus the more powerful test, and the one that was chosen for the experiment.

The test makes use of the null hypothesis, the hypothesis of no differences. It is hypothesized that two methods of indexing are equally good; for instance,indexing with a subset of the index terms originally assigned to a document, such as those terms which also occur in the title of the document, gives as good precision values as indexing with the full set of assigned terms. In other words, it is assumed that for any given search question, chance alone determines which of the indexings gives the best retrieval results. The null hypothesis is stated here, as is usual, in the hope that it can be rejected and that the alternative hypothesis, viz., that there is a significant difference between the two indexing methods, can be accepted. To reject the null hypothesis the observed differences in the sample comparisons must be such that they disagree "enough" with the expectation of no difference. That is, the probabilities associated with these ob-

served values must be small, in particular less than or equal to a critical value α . In the present experiment the data were analyzed for critical values of .05 and .01. As no assumption was made as to the direction of the differences, a two-tailed test was used.

The samples being compared in the experiment consisted of sets of retrieval values associated with the individual search questions. For instance, the recall values for each of the 42 questions before deletion were matched with the corresponding recall values after deletion. Each matched pair was given a difference score $\underline{d}$. The next step was to rank the $\underline{d}$'s for the 42 questions without respect to sign and omitting tied scores. Each rank was then given the sign of the difference it represented, tied $\underline{d}$'s being given the average of the tied ranks. The rationale of the test is that if the null hypothesis were to hold, the sum of the ranks having a plus sign would be about the same as the sum of the ranks having a minus sign. The null hypothesis is rejected if either of the sums is too small. Significance was determined first by finding the smaller of the sums of the like-signed ranks, $\underline{T}$. Then, if the sample size was less than 25, a table of critical values for different significance levels was consulted to see if $\underline{T}$ was small enough to warrant a judgment of significant difference. If the sample size was larger than 25, then $\underline{p}$, the probability of the observed difference,was determined by computing:

$$z = \frac{T - \mu_T}{\sigma_T} = \frac{T - N\,\frac{(N + 1)}{4}}{\sqrt{\frac{N(N + 1)\ (2N + 1)}{24}}}$$

z measures the closeness of T to the mean of summed ranks, and a table gives the probability p associated with the value of z at a given significance level. The null hypothesis is rejected if p is less than or equal to α .

A comment about the use of the statistical test in this experiment: although there are 42 questions, the samples compared did not always consist of 42 values. Partly, of course, samples were depleted by the occurrence of tied scores. In the case of precision, however, a more serious reduction in sample size occurred owing to the fact that for many questions precision values were indeterminate at the higher cutoff values since nothing was retrieved and, formally, precision equaled 0/0; and these questions consequently had to be omitted from consideration. This was unfortunate, since the more the sample size is diminished the less power the statistical test has and the more limited the generalizability of the results.

Even in a more general way the inferences which can be drawn from the experimental data, using statistical methods, are limited -- they are limited by the context of this single and rather small experiment. It is not clear, and it cannot be presumed, that the sample data used in the experiment is representative of

a population consisting of any search request addressed to any collection of documents. It is possible that the results are descriptive only of this particular collection and this particular set of questions.

The Data

The original Cranfield II collection consists of 1400 documents and 279 search questions. Most of the documents are on the subject of aerodynamics, but a small number of them deal with aircraft structures.[1] The effect of the subject area of the collection on the test results is an unknown[2] and as such qualifies the generalizability of any results using the full data or a subset of the data. The 1400 documents comprise 173 "base documents," 1018 papers that were cited in the base documents and 209 "further" documents selected by students or by the method of bibliographic coupling for their presumed relevance to the set of search

---

[1]The purpose of this was to examine the effect of two dissimilar subjects included in one collection. See Cleverdon, Mills and Keen, Factors Determining the Performance of Indexing Systems, Vol. 1, 19.

[2]"We find it impossible to say categorically that the subject area of the test collection did not have an influence on the . . . results." (Cleverdon and Keen, Factors Determining the Performance of Indexing Systems, Vol. 2, 256.) However, Salton points out that the Cranfield documents are substantially more technical in nature and the collection as a whole more homogeneous than most. He speculates that because of the homogeneity of the collection word normalization and synonym procedures are not so effective as for other collections. (Salton, "Computer Evaluation of Indexing and Text Processing," p. 28.)

questions.[1]

The 279 questions were obtained from the authors of the base documents. Each author was asked to state in the form of a search question the reason he had for undertaking the research that led to the writing of his paper. He was asked also to compose up to three supplementary questions which either arose in the course of his work or which could be imagined as being put to an information service. A total of 640 questions was obtained, but of these only 279 were selected for use in the experiments. To be selected a question had to satisfy the criteria: it had to be grammatically complete; and there had to be two or more documents in the collection assessed as relevant to the question by the author submitting the question.

Each document was examined for its relevance to each question, an impressive and "onerous" task involving over half a million judgments. The procedure was as follows: each author, when asked to formulate search questions on the basis of his paper, was at the same time asked to judge the documents he cited in his paper as to their relevance to the questions. Relevance was judged according to a 5-degree scale, from relevance 1 for documents which completely answered the question, to relevance 5 for documents of no interest whatsoever. There were, of course, in the 1400-

[1]While not available for the full document collection, certain characteristics of the base documents are given: each paper contained in its bibliography at least two references in English that were dated 1954 or later: over half the papers were from one journal, the Journal of the Aerospace Sciences; for the most part the authors and bibliographic origin of the papers was American. (Cleverdon, Mills and Keen, Factors Determining the Performance of Indexing Systems, Vol. 1, 19, 20.)

document collection,documents other than those cited by the author that were relevant to his questions -- so every document in the collection had to be examined in relation to every question. The task of "assessing relevance" was performed preliminarily by five students in the field of aerodynamics. But also, as a supplementary measure, preliminary assessments were obtained "automatically" by bibliographic coupling: a document was considered relevant to a search question if it had 7 citations in common with the base document that generated the question. The last and crucial step, i.e., the actual relevance judging, was to send the abstracts of documents thought relevant to a particular question to the author of the question, asking him to make the decision whether the relevance assessments obtained by the students and by bibliographic coupling were actually valid. Asking the author of a question to be the final arbiter of relevance is realistic,and the objection cannot be made that there were documents judged relevant that were really irrelevant. It is not clear, however, that all documents relevant to the questions were found -- that is, some documents preliminarily assessed as irrelevant might really have been relevant. This is another factor that must be considered as qualifying the results obtained using this data. (A fuller discussion is given in the next chapter, pp. 121 ff) On the average seven relevant documents per question were found.

The indexing of the documents in the collection was a post-coordinate natural language indexing. Natural language phrases, consisting of one or more words, were assigned to the documents.

These phrases presumably designated "concepts." The terminology is perhaps misleading or unnecessary[1] -- the condition imposed on the indexing by the use of the word "concept" is that vague and ambiguous words, words which taken singly might be useless as retrieval handles (eg., modifiers such as "high"), had to appear in conjunction with other words which would provide context and thus, perhaps, a more solid image. Each of the concepts was weighted by assigning to it a value indicative of its relative importance in the document. A range of six weights was adopted, the highest weight being 10 and the lowest 5. For the most part weights were assigned on a subjective basis, depending on whether the concept was in the main general theme of the document or in a major or minor subsidieary theme. Individual terms within a concept were given the weight of the concept, and if a term appeared in more than one concept in a document, it was given the weighting of the more heavily weighted concept.[2]

The main objective of the Cranfield effort was to test the effect of various index languages on the performance of retrieval systems. Indeed this is the rationalization for the hypothesis of concepts -- a concept language was one of the languages to be tested. Another index language tested at Cranfield was called a "single term language."[2] The name is somewhat wrong in that a single term can be thought of as consisting of one or more words,

[1]See footnote 1 on p. 56.

[2]Cleverdon, Mills and Keen, <u>Factors Determining the Performance of Indexing Systems</u>, Vol. 1, 55.

[3]Ibid., p. 59 ff.

but what is intended is that index terms be regarded as single words or descriptors. This language was formed by taking individual words out of the context of the phrases in which they appeared. For instance, if "finite wings" was assigned to a document, this was to be regarded as equivalent to assigning the two terms "finite" and "wings." At Cranfield a vocabulary list of the unique single word terms used in the indexing of the 1400 documents was drawn up. In constructing the list, use was made of certain minor normalizations, representing "initial controls" of the indexing language. Since roughly the same procedure was followed in the present experiment, these normalizations or initial controls are listed:

"(1) Singular and plural forms were confounded.

"(2) American and English and other variant spellings were confounded: e.g., gage and gauge, fiber and fibre, Von Karman and Karman.

"(3) Certain qualifiers of terms (affixes, hyphenated forms which were sometimes separated, etc.) were disregarded, e.g., builtup, pitch-up, rolled-up, etc. were treated as built, pitch, rolled; ellipse-like, jetlike, etc., were treated as ellipse, jet.

"(4) Numbers as qualifiers were separated and treated as separate terms; e.g., Mach 6 became 'Mach' and '6', N.P.L. 18 x 4 (a wind tunnel) became 'N.P.L.' and '18 x 4'."[1] The vocabulary list numbered 3094 single words. In the indexing of the 1400 documents, the total number of "single term" postings was 43,857,

[1]Cleverdon, Mills and Keen, Factors Determining the Performance of Indexing Systems, Vol. 1, 58.

the average depth of indexing was 31.3 terms per document and the average indexing breadth was 14.2.

What has been described are some of the basic features of the Cranfield II experimental data. In the present experiment it was a subset of this data that was used, a subset consisting of 200 documents and 42 questions. The documents and questions were chosen, with the help of a member of the Cranfield group, by Professor Salton for his experimenting at Harvard with the SMART program. A characteristic of this smaller subset of data is that all documents in the 1400-document collection that were relevant to one of the 42 questions were included in the 200-document subset.[1] There were on the average 4.7 relevant documents per question. A possible objection to the Salton-Cranfield data is that there are too few documents and questions to yield results that are generalizable. It is believed, however, at least at Cranfield,[2] that the smaller set of documents is representative of the larger data base, especially for the case of single term indexing. That is, already in previous experimenting the data has been accepted as a reliable inferential base. While this is no guarantee, the

[1]This is not strictly true. Document 1329 is relevant to question 119 and is not included; nor is document 2289 which is relevant to questions 145 and 146.

[2]"Undoubtedly the size of the test collection . . . is smaller than one would have liked. The test results presented in Chapter 4, Section 1, show that the smaller sets of documents and questions were representative of the complete document collection and question set, but these tests were only concerned with the Single Term index languages . . .However, there appears to be no justification for suggesting that the size of the test collection could have significantly affected the comparison between systems." (Cleverdon and Keen, Factors Determining the Performance of Indexing Systems, Vol. 1, 256.

availability of the data, the fact that the documents are more deeply indexed than in any other document collection (and by professional indexers) and the integrity of at least those relevance judgments made contribute to making the data the best possible for the present experiment.

The data tape sent by Mr. Salton contained the weighted concept or phrase language indexing of the documents, a listing of the titles and abstracts of the documents, the questions and a record of the relevance assessments. In the present experiment use was made of only the indexing of the documents. Questions, relevance assessments and document titles were taken from the original Cranfield publications. To prepare the data for use, before the programming could begin, the following tasks had to be performed.

1. Convert the phrase indexing of the documents to a single term indexing in accordance with the normalization procedures followed at Cranfield.

2. Index the questions.

3. Index the document titles.

4. Construct a relevance file, associating with each question the documents relevant to it.

Though something may be lost in the breaking up of phrases, there were definite reasons in the present study for preferring index terms to be single words rather than phrases.[1] And, for the

---

[1]One advantage to a single word index language is that it is familiar -- keywords and descriptors being now part of standard index usage. The advantage is not negligible in that, in the past,

results of retrieval experiments have tended to be somewhat blurred by an overelaborateness and consequent confusion in the details of the experiments. Where possible it seems advisable to let definitions conform as much as possible to what is easily and already understood.

A second reason for preferring index terms restricted to single words is to safeguard against the possibility that certain deletion procedures could be made to look problematic. For instance, suppose "wings" is deleted from one document and "finite wings" from another. It can be argued that while the same number of "terms" are being deleted, there is an important difference in the units of meaning being removed. The argument would be difficult to meet if one concurred in the view that a word constitutes a unit of meaning. It is, of course, claimed both ways, that as units of meaning words are too small (context must be considered) and they are too big (the unit of meaning must be found at the morphological level). Both claims seem reasonable and rather than getting involved, it seems safest to compromise with common sense by confining index terms along with units of meaning to word boundaries. The only problem then is what is a word boundary, see p. 81.

The use of single words as index terms has the further advantage of permitting retrieval to be carried out on the basis of a relatively simple matching function. The matching function is used to determine the number of overlaps between a document and a search question. For instance an exact (machine-like) match of a question word with an index term assigned to a document constitutes an overlap (wings "matches" wings). Admitting word phrases as index terms, however, introduces cases which are not so clear. Does wings match finite wings? Should this be counted as an overlap? If not, some degree of similarity between document and question is missed. If, on the other hand, it is admitted as a partial (generic) overlap then immediately another variable is introduced into the experiment, viz., search strategy. This is not to deny the importance of the search strategy variable, only it seems advisable to suppress this complication where the emphasis of the experiment is on other factors.

Finally, a reason for preferring single-word index terms -- one which does not so much rest on arguments from simplicity of design -- is that the use of single words as retrieval hooks does in fact adequately serve the purpose of retrieval. In discussing the results of the Cranfield II project, Cleverdon writes: "Quite the most astonishing and inexplicable conclusion that arises from the project is that the single term index languages are superior to any other type." (Cleverdon and Keen, Factors Determining the Performance of Indexing Systems, Vol. 2, 252.) This is all the more impressive as 33 different index languages were compared in the Cranfield project.

most part, it seemed convenient to adopt the word normalizations[1] suggested by Cleverdon (see p. 77). There was one exception: numbers were not used as retrieval terms. Curious to observe is that neither are numbers included in the Cranfield vocabulary list of terms used in the indexing of the original 1400 documents -- the reason, perhaps, being that numbers by themselves, in isolation, are not especially descriptive and might thus be regarded as too common to be used as retrieval terms. In any case, it seems a matter of fairly arbitrary decision whether or not numbers are used in the retrieving of documents. The first task, converting the phrase indexing of the documents to single term indexing, involved another more problematic decision. The trouble lay in the definition of a word. On the Cranfield vocabulary list sometimes a combination of letters would appear as a single word, but in the actual indexing of the documents these letters would appear as two

---

[1]Word normalization procedures are a matter of degree: singular and plural forms of one word might be regarded as the same term; further, word variants, such as "fix" and "fixing," might be regarded as equivalent; still further, synonyms might be compounded and regarded as identical. The literature shows some discrepancies in judging the usefulness in retrieval or word normalization procedures. Cleverdon finds that grouping true synonyms and word forms makes for improvement in performance, but the improvement is relatively small (Cleverdon and Keen, Factors Determining the Performance of Indexing Systems, Vol. 2, 253.) Salton finds that the more thorough normalization inherent in matching word-stems improves search effectiveness less than compounding singulars and plurals. Salton, however, agrees with Cleverdon in admitting that the differences one way or another are not dramatic. (Salton, "Computer Evaluation of Indexing and Text Processing," p. 28.) In light of the nonconclusiveness, it seems as well to adopt the minor normalizations used in constructing the initial Cranfield vocabulary list of 3094 single terms.

words. For instance, "lessthan" is a single word in the vocabulary listing of terms, but on documents it is written as two words. Conversely, sometimes two words on the vocabulary list are run together in the indexing of the documents and appear as one word, e.g., "navierstokes" and "navier stokes." Something had to be decided and the decision was to let the indexing of the documents be determining in the following way: unbroken sequences of letters that occurred in the indexing phrases assigned to documents should be included in the vocabulary list as "single words," except if these were obviously common words, common being decided on by the Cranfield policy for prepositions, adverbs, etc., which is inferable from the Cranfield vocabulary list. In this manner revisions were made and a modified vocabulary list was drawn up which consisted of 3168 terms, as compared with the Cranfield list of 3094 terms. The Cranfield list is given on pp. 221 - 236 of Cleverdon, Mills and Keen, Factors Determining the Performance of Indexing Systems, Vol. 1. The revised list used in the present experiment is given in Appendix A.

Cards were then keypunched for each document-term pair, showing also the weighting of the term with respect to the document.[1] The cards were of the following form:

Document Number	Weight	Index Term
1302	05	BOUNDARY

---

[1]Some of the weights were missing from terms on the Salton tape. In some cases they were dispensable, there being other occurrences of the same term on the same document. Otherwise the weight was regarded as indeterminate.

The cards were alphabetized and duplicates were discarded. A listing of these cards, showing the index terms assigned to the 200 documents, is given in Appendix B.

The indexing of the questions and document titles was kept as automatic (and repeatable) as possible. The rule followed: a word occurring in a question or a document title was to be considered an index term if, under minor normalization (p. 77), it matched a word on the revised vocabulary list. The questions, with the index terms assigned to them, are given in Appendix C. The cards in the question-term file were of the form:

Question Number	Index Term
100	BOUNDARY

The indexing of the document titles can be inferred by looking at the listing of the records in the document-term file. A T was added to a record if the index term assigned to the document was represented in the title of the document (it is only title terms satisfying this condition that are of interest in the experiment, see p. 65). In making the relevance file, the Cranfield distinction of different relevance categories was not maintained, documents of relevance 1 through relevance 4 were considered simply as "relevant." The cards in the question-relevance file took the form:

Question Number	Number of Relevant Documents	Relevant Documents
100	4	1785 1786 1787 1788

A listing of the cards is given in Appendix D.

Programming the Experiment

The data files used in the experiment are the document-term file, the question-term file and the question-relevance file. Before beginning the actual deletion and retrieval operations, three preliminary tasks, for which programs were written, were performed.

1. The terms used in the indexing of the documents were ordered according to their breadth or frequency, and the depth, breadth and posting statistics were taken. The total number of postings was divided by four, and the terms accounting for the postings in each quartile were separated into four not quite but almost equal sets.[1] For use as deletion decks, the quartile terms together with their frequency of occurrence were output on punched cards. A list of the full set of terms divided into the four subsets is given in Appendix E, and the distribution graph is shown in Appendix G, p. 93.

2. The number of non-title and non-weighted-10 terms in each document was counted -- the information needed for this being already punched on the records in the document-term file. Separately for each document and for each of the two types of terms, the same number of terms was selected at random from the original set of index terms assigned to the document. The program to do this punched on a V on a record in the document-term file if the term was selected as a member of the randomly chosen set corre-

[1]See footnote 2, p. 412, Chapter III.

sponding to non-weighted-10 terms; an S was punched if the term belonged to the random subset corresponding to non-title terms. Thus in the document-term records for a given document, the records marked with S equaled in number those not marked with a weight of 10.

3. From the document-term file all records for index terms that were not also used in the indexing of the questions were removed. This reduced the size of the file necessary to search through in the retrieving operation by about a third. The reduced file was called the small document file and the original file the large document file. A listing of the small document file is given in Appendix F. Note the terms are alphabetically ordered and following each term are the numbers of the documents that are indexed by the term. The reason for this format was to enable one to manually simulate (and check) the automatic retrieval operation by matching question terms (Appendix C) with the document terms in the small file (Appendix F).

The deletion operations were as follows. The four deletion decks showing the index terms together with their frequency of occurrence were each alphabetically ordered. The terms in each deck were then matched against those on the records in the small document-term file, which also was alphabetically ordered. A match signaled that the document-term record was to be deleted. (The listing in Appendix E showing the frequency distribution of terms is divided into four parts, indicating, thus, which terms were removed from the document indexing in each of the quartile deletions). The deletion of non-title terms, non-weighted-10

terms, V and S terms, did not require the matching of two sets of records. A program was written to delete a term-document record if it did not bear a T; if it did not bear a weight of 10; if it did have on it a V; if it had on it an S. (Which terms were removed in each of the deletions can be seen by referring to the document-term records listed in Appendix B.) After each deletion, depth, breadth and posting statistics were taken.

In the retrieval operation, records in the question-term file were matched against records in the small document file, each file being alphabetically ordered. Only exact, machine-like matches were permitted. Thus 100 BOUNDARY, a record in the question-term file, had a match with 1302 15 BOUNDARY, a record in the document-term file. For each question all documents retrieved by the individual words in the question were ordered according to frequency of occurrence. For instance, one document might respond to five words in the same question. This document then, is said to have a frequency of 5 for that question -- which is simply another way of saying that the document is retrieved in response to the question at the 5 overlap level. The retrieval operation just described can be replicated by matching the question terms in Appendix C with the document terms in Appendix F. Fig. 1 is a sample of what the ordered retrieval output for one question would have looked like at this point, had it been printed out.

The next step was to record which of the retrieved documents were relevant. This was accomplished by consulting the question-relevance file in which documents judged relevant to each question

were listed. In the set of ordered documents retrieved by a given question, a document relevant to the question was marked with a star (see Fig. 1).

The retrieval output for each question was then evaluated. Recall and precision were determined at 5 overlap levels (cutoff points), k, denoting cutoff value, ranged from 1 to 5.[1] The mechanics of the evaluation consisted simply of plugging in the appropriate formulas the values obtained by counting different sets of documents in the ordered retrieval output. For each question q and for each cutoff point k,

$$\text{Precision} \qquad \frac{\text{number of starred documents retrieved of frequency} \geq k}{\text{total number of documents retrieved of frequency} \geq k}$$

$$\text{Recall} \qquad \frac{\text{number of starred documents retrieved of frequency} \geq k}{\text{total number of documents relevant to question q}}$$

(The program was directed to the question-relevance file to get the value for the denominator of the recall formula, i.e., the total number of documents relevant to question q.)

Expected Search Length was determined for five values of s* ranging from 1 to 5. The esl values were obtained by evaluating

[1]Larger values of k were not considered for the reason that the average number of documents relevant to any question was 4.7, making it improbable that for cutoff points higher than 5 enough documents would be retrieved to make the results statistically meaningful. Similarly, values of s* above 5 were not considered, it being unlikely that requests for more than 5 documents could be satisfied in sufficient number to make the results statistically worthwhile.

the esl formula for each ordered document set. Let k = the frequency or overlap level at which the request is satisfied.

$$\text{esl}\ (q) = j + \frac{si}{r + 1}$$

where j = number of unstarred documents of frequency $> k$

x = number of starred documents of frequency $> k$

r = number of starred documents of frequency k

i = number of unstarred documents of frequency k

s = s* - x (s* is the number of documents requested)

There were some special cases in the esl program. It was necessary before using the esl formula to ascertain whether or not the request being considered could be satisfied in the document collection. For instance, it had to be asked if there indeed existed five documents relevant to the search question. If the answer was yes, the formula was applied; if not, the question was given no esl value and was not included in the averages. Another problem was that it sometimes happened that a request could be satisfied but only at the 0 overlap level. In the retrieving operation, documents were ranked according to a frequency of 1 or greater, that is, only documents with at least 1 overlap in common with a given question were "retrieved." Unretrieved documents, documents with 0 overlaps in common with the question were ignored, i.e., skipped over, by the program. This, while efficient for the most part, had the difficulty that for those cases where k = 0, the esl formula as it appears above would not work. Thus for the case where k = 0: when s* is not satisfied by the time the end of the first overlap level is reached, and there are still relevant documents in the

collection; a subprogram was introduced, by which the esl variables were differently defined.

j = number of unstarred documents with frequency $\geqslant 1$

x = number of starred documents with frequency $\geqslant 1$

y = number of documents relevant to the question in hand

r = y - x

i = 200 - (x + j) - r

s = s* - x

Printed output was obtained at this stage. It took several formats, one format being a 42 x 15 matrix, the columns precision, recall, and esl values, the rows question numbers:

Question	Cutoff 1		s*=1	Cutoff 2		s*=2	. . .	Cutoff 5		s*=5
	P	R	esl	P	R	esl		P	R	esl
7079	0.05	1.00	22.00	0.14	0.33	38.00	. . .	---	0.00	---
7100	0.02	1.00	1.50	0.04	0.75	18.31	. . .	---	0.00	---
.	.	.	.	.	.	.	. . .	.	.	.
.	.	.	.	.	.	.	. . .	.	.	.
7360	0.05	1.00	2.18	0.12	1.00	2.37	. . .	---	0.00	---

The output in matrix form was punched on cards, one row to a question, for the purpose of facilitating two further operations: obtaining the mean and standard deviation values for precision, recall and esl, and running the test to determine statistical significance. The mean and standard deviations were found for each column of values. In the case of precision and esl, "dummy" values

signifying "value indeterminate" or "request unsatisfied" were excluded from the averages. Then each column of values (e.g., precision values for each of the 42 questions) obtained by retrieving documents after each of the deletions was compared for significant difference, using the Wilcoxen Test, with the corresponding column of values for the no-deletion case. Corresponding columns of values were also compared for the non-title _vs_. S deletion case and for the non-weighted-10 _vs_. the V deletion. Output of the statistical program showed the ranking of differences in values as well as values for z, T, μ_T and σ_T (see Wilcoxen Test description, pp. 69 - 73).

Summary

The experiment described consisted of two stages. In both stages the indexing of a collection of documents was varied by the systematic deletion of index terms from documents. Documents were retrieved in response to search questions after each of the deletions and the output was evaluated in terms of precision, recall, and Expected Search Length. The Wilcoxen Test was used to determine whether the difference in retrieval effectiveness in the before-and-after-indexings was statistically significant.

In the first stage of the experiment index terms were non-randomly deleted for the purpose of testing the effect on retrieval performance of varying the specificity or operational breadth of the indexing. In four separate deletions index terms of four different breadth categories were deleted from the indexing of the

documents. The question asked was, "Of the index terms assigned to documents, which function most effectively in retrieval, the most used or popular terms, or those which are used relatively infrequently?"

The second stage of the experiment was designed to meet the objection that if there is something which distinguishes good indexing from bad, then this is to be found in the relationships individual terms bear to the documents they index, in their textual warrantability rather than in a statistical property such as operational breadth. Index terms assigned to a document but not represented in the title of the document were deleted and the indexing was compared with a set of terms chosen randomly from the assigned terms to a comparable depth. Non-weighted-10 terms were deleted, terms were randomly deleted to the same depth and the two indexings were compared for retrieval effectiveness. The question asked in the second stage of the experiment was, "Do two indexings of comparable average breadth (depth) differ significantly in the retrieval results they produce because one consists of 'quality' indexing and the other does not?"

CHAPTER III

RESULTS

Indexing With Broad and Narrow Terms

Depth, Breadth and Posting Statistics

In the first stage of the experiment both broad and narrow terms resp. were deleted from documents and the retrieval effectiveness of the indexings before and after deletion were compared. Figure 2 (p. 412) shows the distribution, before deletion, of the terms used to index the documents in the collection.[1] The four horizontal lines cutting the distribution curve indicate the upper and lower bounds on posting frequencies of the four sets of terms corresponding to the four separate deletions. In each deletion terms comprising twenty-five percent of the total number of postings were removed from documents in the collection. In the first deletion broad terms were removed, those occurring between 32 and 143 times (first quartile deletion). Secondly, terms with

[1]Note that the distribution is plotted on log-normal graph paper. The vertical axis (log-scale) shows x = number of postings, the horizontal axis (normal probability scale) shows S = the percentage of terms having x or fewer postings. Quite predictably, the distribution of index term usage is representable as a straight line, that is, the distribution is log-normal. See Nona Houston and Eugene Wall, "The Distribution of Term Usage in Manipulative Indexes," American Documentation, XV, (April 1964), 105.

13 to 32 postings per term were deleted (second quartile deletion). In the third deletion terms with a frequency from 5 to 13 were deleted (third quartile deletion). Finally, narrow terms[1] were deleted, those posted between 1 and 5 times. With each deletion the number of postings removed was 5174,[2] thus at each deletion average depth was decreased from 34.5 to 25.9 and average breadth from 2.17 to 1.63. Table 1 shows the depth, breadth and posting statistics for the indexing of the collection before any deletion and for the four indexings resulting from the original indexings altered by deletion.

Recall Statistics

Recall results are shown in Tables 2,4 and 5 and in Figure 3 (Appendix G). Table 2 shows the mean recall values over the questions in the sample for each quartile deletion, at each of five cutoff points. Next to each value is written the standard error. The standard error in the recall value is computed from the standard deviation of the sample measurements by dividing the standard deviation of the sample, s, by the square root of N:

---

[1]Vocabulary terms which were not used in the indexing of the 200-document collection were not "deleted." Strictly then the narrowest terms were never deleted. In the discussion of the results the expression "narrow terms" refers to terms posted between 1 and 5 times. "Relatively narrow terms" are terms posted between 5 and 13 times; "relatively broad terms" are those with 13 to 32 postings per term; and "broad" terms are those with 32 to 143 postings.

[2]5174 is an average, the range of values is from 5170 to 5178. It was desired that every occurrence on a document of a given quartile term be deleted, which made it impossible to delete exactly the same number of postings each time. See p. 64.

$\sigma_{\bar{k}} = \frac{s}{\sqrt{N}}$.

It can be seen from Table 2 that the standard error in the recall values is consistently fairly small, ranging from 0.01 to 0.06. An error in this range is of small importance at low cutoff points where the recall figures tend to be high. At high cutoff points, however, the error becomes proportionately quite large. Generally, as will be seen, any values obtained at high cutoff points are less reliable than those obtained at low cutoff points, and must be regarded with a certain suspicion.

Table 4 shows the recall values for the no-deletion case and for each quartile deletion,and these are juxtaposed with the corresponding precision values. For both recall and precision, it is indicated when a particular value differs significantly from the corresponding value in the no-deletion case.

Figure 3 shows the precision-recall operating curves for indexing before deletion and the indexings after each of the quartile deletions. The operating curve nearest the top rightmost corner represents the best retrieval: 100% precision and 100% recall. Correspondingly the curve falling closest to the bottom left of the graph represents the poorest retrieval.

Table 5 should be looked at in conjunction with Fig. 3 showing the operating curves, in that it indicates when distances between any two of the curves, e.g., indexing with 1st quartile terms removed and indexing with 4th quartile terms removed, differ significantly.

Recall Drops in Proportion to Breadth of Term Deleted

As was to be expected, recall generally drops as index terms are deleted from documents. The largest drop in recall comes with the deletion of the broadest terms and the smallest with the deletion of the narrowest terms. The fact that recall drops in proportion to the breadth of term deleted is not entirely obvious. It is not obvious since at each deletion the same number of postings were deleted, that is, the same number of retrieval hooks were removed from documents, independently of whether the terms deleted were themselves broad or narrow. But then it can be observed that the factor operative here is not postings but overlaps. Confining attention for the moment to the number of documents retrieved (rather than to recall per se), it seems clear that the amount of material retrieved is determined by the specification of the retrieval condition, viz., by the specification of the number of index terms a document and question must share for the document to be considered retrieved in response to the question. The number of overlaps that can be associated with any term is the frequency of the term in the question indexing times its posting frequency in the document collection. In that terms frequently posted on documents tend also to be used frequently to index questions, it is more probable that a broad term will account for an overlap rather than a narrow one. Thus it is more likely that a greater number of documents will be lost from a given overlap category when broad, as opposed to narrow, terms are deleted. In other words, it is not the number of postings alone, but also the

number of times different terms are used to index questions that determines the number of documents retrieved by the terms.[1] It is perhaps obvious that the amount of material retrieved in a system is not a simple function of the total number of terms posted to documents in the collection. This fact, however, is useful in explaining why the quantity and, as will be seen, also the quality of retrieval can vary considerably for collections having the same number of total term postings, in effect the same average indexing depth. Important also is the number of different terms posted at least once. The retrieval behavior of a system is different if many infrequent terms are deleted from the indexing of documents or if a few broad terms are deleted, even though the resulting indexings are of like depth.

Fewer documents are retrieved when broad, rather than narrow, terms are deleted, but as yet this says nothing about recall, the relative proportions of relevant and irrelevant documents retrieved. It seems plausible that a retrieval system should work at least to some extent. Indeed such a system would seem perverse or exhausted if the retrieval of relevant documents did not increase as more documents were retrieved -- it would be better not to retrieve at all. The recall results can be explained then

[1]The same conclusion can be reached by considering a single question. A very broad term occurring in the question, for instance "coefficient," can at a single match retrieve 50 documents. A narrow term such as "isobaric" can bring in only one document. Broad and narrow term deletion will affect the amount of material retrieved in response to this question differently. It can be assumed that what is true of this question is true of all questions -- in general, fewer documents are retrieved when broad terms are deleted.

by introducing the assumption that if a term has retrieval power (brings in documents) it has, when used to index a question, also recall power (the power to bring in relevant documents). Generally then, comparing broad and narrow terms, fewer documents are retrieved when broad terms are deleted from documents, and thereby the largest drop in recall comes with the deletion of broad terms.

Exceptions to the Recall Result

There are, however, two exceptions to the general result that recall drops in proportion to the breadth of term deleted. The first exception is that recall is not in the slightest affected at the first cutoff level when the 4th quartile (infrequent) terms are deleted. This is somewhat surprising, especially when one considers that in this deletion over 1000 different index terms were removed from documents. Moreover, the deletion of these terms even at cutoff 2 does not affect recall significantly. The implication is that the over 1000 terms in the indexing vocabulary which have been posted five or fewer times are superfluous when retrieval is performed at low coordination levels. By way of explanation: broad terms cover so many documents, it seems unlikely that at a coordination level as low as 1, an infrequently used term could bring in something new. The term "flow" for instance retrieves 75% of the collection, while a term such as "isobaric" has at best the potentiality of retrieving one document out of 200 -- the likelihood that the single document retrievable by "isobaric" does not also have at least a few other terms as frequent as "flow"

among its 34 other index terms is fairly slight. Where the requirement for retrieval is weak (eg., a document need have only one overlap with a question to be considered retrieved), there is almost as good a chance that a document indexed with 35 terms will be matched with a given question as the same document when nine narrow terms are removed from its indexing. In other words, if retrieval is to be performed only at low coordination levels, there is an unnecessary redundance in indexing documents to a depth of 35 terms. At high coordination levels this is not so true. "Isobaric" is no longer redundant if the cutoff point is high and if its presence on a document is essential to secure the needed coordination for retrieval. It could be said that the retrieval power of broad terms is diminished and that of narrow terms increased as the cutoff point is raised. The higher the cutoff point, the more nearly the retrieval power of broad and narrow terms is equalized.

The second exception to the general result that recall drops in proportion to the breadth of term deleted is at cutoff 5 where 3rd and 4th quartile deletions give like recall. Note that already at cutoff 3 the distinction between these terms, i.e., narrow terms (1 to 5 postings) and relatively narrow terms (5 to 13 postings) begins to become statistically obscured (see Table 5). The explanation again is that at the higher coordination levels there is a tendency for the retrieval power of terms of different breadths to become equalized. Rather naturally this tendency is first exhibited by terms that initially differ little in breadth

or retrieval power. Table 5 shows that generally (there are only two exceptions) there is no significant difference in recall between deletions of neighboring quartiles: between 1st and 2nd quartiles; between 2nd and 3rd quartiles; between 3rd and 4th quartiles.

Precision Statistics

The precision results are shown in Tables 3,4,6 and Fig. 3 (Appendix G). Some caution is needed in the statistical interpretation of the values for precision. Changes in recall when index terms were deleted from documents were generally statistically significant at the .01 critical value. However, the changes in precision resulting from the deletion of terms were fairly often not significant, even at the .05 critical value.[1] There is a special difficulty with the significance of precision values at the higher cutoff points. The sample sizes for precision values at these points tended generally to be small. Even before the deletion of index terms there were questions that retrieved no documents at all. Such questions could not be included in the sample. Then there were questions that retrieved some documents before deletion but none after, that is, precision went from some positive (usually small) value to 0/0. Indeterminate changes can-

[1] A star beside a value indicates that this value represents a .05 significant change over the no-deletion case. A double star indicates that the changed value is .01 significant. An X, which is beside some of the precision figures, indicates that the sample size used to determine significance was too small (<6), primarily because of changes in precision which were indeterminate, for the statistical test to be applicable.

not be judged or included in judgments about differences -- they amount to lost cases. The small sample sizes for precision at the higher cutoff points is unfortunate in that the power of a statistical test (the probability of rejecting a hypothesis when it is false) is diminished as the size of the sample decreases. The implication is that inferences about what happens to precision at cutoff 5, to some extent even at cutoff 4, cannot be taken as very reliable.

As an illustration of the difficulty with significance at higher cutoff levels, see the precision value (.90) at cutoff 4, 1st quartile deletion. This value represents an increase in precision of nearly 100%, yet in this case the difference in precision is not significant statistically. The sample size here for the Wilcoxen Test is 6 -- had it been any smaller no judgment could have been made either way as to significance. To show that there is a significant increase in precision with a sample size as low as 6, the Wilcoxen Test requires that 6 out of 6 precision figures increase as a result of deletion. That is, if the outcome is to be only .05 probable, every question in a sample of six questions must show an increase in precision (actually there was an increase in precision in five out of the six cases).

In the example given above, one can allow that the statistical test is suspect, lacking in power because of the marginal sample size. This seems credible, especially as a difference of from .48 to .90 seems so large. On the other hand the precision values themselves might be questioned. What is the meaning of "average

precision" where samples are small? The precision value obtained at cutoff 4, 1st quartile deletion,is an average of only twelve values. From a quick and intuitive assessment one might say that the difference here over the no-deletion case seems significant because it looks large and the probable error is fairly small ($\pm$.08). But,in saying this,one is making a parametric judgment of sorts, a judgment about a difference in averages (means). From a statistical, and less intuitive, point of view it can be asked whether the comparison of means is a reliable indication of difference, when the means themselves are means over a small sample. Especially when there is no a priori knowledge about the distribution of the means. While it can be argued that when the sample size is small the statistical test is not reliable, for similar reasons it can be argued that the average precision figures themselves are suspect.

It can be questioned generally whether average precision is a good statistic to describe intuitively or otherwise the comparative retrieval effectiveness of different indexing methods. In cases where there are only a few questions which retrieve documents -- such as happens at high coordination levels -- its meaningfulness seems especially questionable. For instance, in Table 6 it can be seen that the precision differences when the term quartiles are deleted at cutoffs 4 and 5 are seldom significant. It can be argued that this reflects statistical uncertainty, rather than any bona fide result. Anything that is said about precision at cutoffs 4 and 5 must be regarded as suggestive only.

Precision is Never Improved by the Deletion of Narrow Terms

Precision tends to change in proportion to the average breadth of term deleted from the document indexing. There is a high average percentage increase in precision when the 1st quartile (broadest) terms are deleted -- 86%. When the narrowest terms are deleted precision does not change significantly. In two cases, at the lower cutoffs 1 and 2, the change is not even observable, a consequence presumably of the already-noted redundancy of narrow terms when used in conjunction with broad terms at lower coordination levels. (At the higher cutoff points the change in precision when 4th quartile terms are deleted is observable, but not statistically significant.)

The change affected in precision by the deletion of terms is generally a change for the better. Perhaps the most interesting result is the exception: precision is <u>never</u> improved by the deletion of 4th quartile terms, and only at cutoffs 1 and 2 is it improved (and then only slightly) by the deletion of 3rd quartile terms. This result constitutes several counterinstances to the "tradeoff hypothesis."[1] At the same time this result gives weak support to the hypothesis that the narrower the terms used in indexing the better the precision of the results. Only weak support because it must be admitted that the precision values obtained for 3rd and 4th quartile deletions are not significantly different from the precision values before deletion -- except in one case

[1]See pp. 18-19.

(cutoff 4, 3rd quartile deletion). The exception may be regarded as suggestive of a general tendency.

Counterinstances to the Tradeoff Hypothesis

At cutoffs 3,4, and 5, the deletion of 3rd and 4th quartile terms gives results contrary to the expected tradeoff between precision and recall. It can be asked how this could happen, how the deletion of terms, which decreases recall, at the same time decreases precision. In the random deletion case, as modeled by Swanson,[1] precision generally improves. Swanson hypothesizes that the high overlap categories are denser in relevant than irrelevant documents than are the lower overlap categories. The net result of deletion, at any but the highest cutoff point,[2] is a larger ratio of relevant to irrelevant documents, that is, an improvement in precision.

Swanson's hypothesis is borne out by the data in the present experiment. Nevertheless, in some cases, precision does not improve with the deletion of index terms from documents. To explain why precision behaves in this way, it can be observed that even though the conditions of the hypothesis hold, precision can get worse if a greater proportion of relevant than irrelevant documents lose overlaps in the deletion process. If the deletion process is a random one, it is as likely for a relevant document as an irrelevant one to lose an overlap. But this is not true when

[1] Swanson, "On Indexing Depth and Retrieval Effectiveness."

[2] Ibid.

terms are systematically deleted from documents. Under conditions of nonrandom deletion the operative factor affecting the change in precision (for better or for worse) is the relative proportions of relevant and irrelevant documents that are dropped from a given overlap category. One cannot presume that this relative proportion will be the same for broad and narrow term deletions. Indeed this is just what the experiment was designed to test, viz., whether broad terms or narrow ones function more effectively in the retrieving of relevant documents. As can be seen from Table 3 and Fig. 3, when broad terms are deleted precision increases, that is, the ratio of relevant to irrelevant documents increases at a given overlap category. But the reverse happens when narrow terms are deleted, at least at cutoffs above 2: the ratio of relevant to irrelevant documents decreases and precision gets worse.

As was mentioned, any effect narrow terms might have at the lower cutoff values (1 and 2) is obscured by the gross effect of broad terms. At the higher cutoff values, however, the effect of narrow and relatively narrow terms (3rd and 4th quartile terms) becomes more apparent. At these values the number of documents retrievable by broad and narrow terms is more nearly equalized. When this is the case narrow terms are more effective in retrieving relevant documents than broad terms. This suggests a tentative answer to the question originally posed, viz., which terms are better for retrieving relevant documents, broad or narrow terms? It can be said that at cutoffs above 2, narrow terms are at least relatively better, since deleting them does not even give

the benefit of tradeoff, both precision and recall get worse. This result is interesting at cutoff 3. At cutoffs 4 and 5, it must, of course, be regarded as unfirm.

The Effect on Precision of Deleting Broad Terms

The above results are given further support by the fact that the deletion of broad terms at cutoff 3 and above is seen to result in better retrieval performance, signifying thus that at these levels broad terms are not especially good as retrieval hooks (see the operating curves in Fig. 3). Intuitively it would seem that broad terms should be especially necessary if retrieval is to be performed at high coordination levels, simply to insure that there are some documents retrieved, i.e., that there is something in the intersection of document sets retrieved by the coordinated terms. As far as precision is concerned, this consideration is irrelevant -- it is the quality of the documents retrieved that is important, not the fact that documents may or may not be retrieved. Questions that do not retrieve documents are not included in the evaluation of average precision. The consideration more appropriately applies to recall -- however,if recall at the higher cutoff values had been disastrously affected by the deletion of broad terms from the document indexing the operating curve for the deletion of 1st quartile terms would never have crossed the no-deletion curve. Note that the operating curve for the deletion of broad terms crosses the no-deletion curve by virtue of three high precision values, those at cutoff points 3,4, and 5. The latter

two values again are suspect, the one representing a seemingly large jump over the no-deletion case is not actually significant;[1] the other value is obtained on the basis of a sample size so extremely small (2) that it is virtually meaningless. The third figure, however (cutoff 3, 1st quartile deletion), is the most stable as well as the most dramatic; it is the figure that effects the crossing of the operating curves; the sample size is fairly large; the standard error is only $\pm.0568$; the precision value represents one of the more highly significant differences from the no-deletion case, significant at less than the .01 level. Cutoff 3 seems to be a critical point. It was observed before that the deletion of narrow terms below this point had little or no effect on precision or recall. At cutoffs of 1 or 2, retrieval is effected by the strength of broad terms alone. At cutoff 3, however, the retrieval power of the low frequency terms begins to become apparent. It would seem from looking at the operating curves that the behavior of broad terms on either side of the critical 3 cutoff is also different. At cutoff 3 or above their removal results in a better operating curve, but not below this point. Table 6 shows that the deletion of broad terms at cutoff 1,2 or 3 results in indexing significantly better than any of the other indexings obtained by deleting terms, as well as no-deletion indexing. Moreover, the precision values are not suspect at these low cutoff points. The implication is that broad terms do

[1]See p.100 for a discussion of this case.

not make for good precision.

Deleting broad terms is a method of improving precision. There is, however, another method of improving precision and this is to raise the cutoff point. And indeed the operating curves show that the deletion of broad terms at low cutoff points is not as effective a move in improving precision as raising the cutoff point. At cutoff 1, no deletions, a 120% increase in precision can be bought at a 15% loss in recall by deleting the 1st quartile terms. By raising the cutoff to 2 a 240% increase in precision can be achieved at a 16% loss in recall. Actually, the price paid in recall increases as the cutoff point is raised. For instance, at the 3rd cutoff point the deletion of these terms represents only an 87% increase in precision at a 56% loss in recall (compared to the 120% precision and 15% recall loss at cutoff 1). Regardless of the precision-recall preference of an individual user, there is more to be gained by deleting broad terms at cutoff 1 than at cutoff 3. The performance curve for the 1st quartile deletion is poor at low coordination levels only because raising the cutoff point is so much better an alternative.

Primarily what is shown by the operating curves is the relative usefulness of the two devices to improve precision: raising the cutoff point and deleting broad terms. An answer is given to the question: how can it be said that narrow terms make for good indexing when using broad terms at higher coordination levels might give better retrieval results? The answer, which, of course, is relative to the statistical properties of the Salton-Cranfield collection, is that up to the critical cutoff point (3 overlaps)

it is indeed better to reduce the amount of material retrieved by raising the cutoff point. At coordination levels of 3 or above the more effective measure is to delete the broadest terms. The reasonable user will operate somewhere along the curve defined by the points: 1 cutoff, no deletion; 2 cutoff, no deletion; 3 cutoff, 1st quartile deletion; 4 cutoff, 1st quartile deletion; 5 cutoff, 1st quartile deletion.[1] At which point on the curve the user decides to operate is a matter of individual preference, depending on whether he favors precision or recall -- in effect, depending on how many irrelevant documents he is willing to search through to find what he needs.[2]

---

[1]An intuitive estimate of the distances represented between the points on the optimal operating curve can be obtained by describing an imaginary situation where a user is in dialogue with the retrieval system. This user sets his retrieval condition at the 1 cutoff point and finds that he retrieves 50% of the collection. He wants to improve precision -- it is hard to suppose anyone at this point not wanting to improve precision. A decision is made as to how much recall can be sacrificed in the interest of better precision. Suppose that the user wanting more precision is willing to pay for it by an equal (percentagewise) loss in recall. To improve precision then, he would be led to raising the cutoff point until the third cutoff level is reached, at which point the imperative would be to delete 1st quartile terms. He would operate at cutoff 3, 1st quartile deletion. Any further attempt to improve precision would bring no improvement worth the cost, given of course, this user's particular tradeoff preference.

[2]It has been suggested by Swanson ("Searching Natural Language Text by Computer," Science (October 21, 1960), p. 1102) that a decision of this sort be expressed in terms of a penalty factor, the "penalty" being the time spent or cost in reading irrelevant material. Thus the penalty factor (p) is a variable which can take on arbitrarily assigned values. Retrieval results can then be assessed in terms of a scoring algorithm, given by $R - pI$, where R and I are the respective amounts of relevant and irrelevant material retrieved. This scoring algorithm, which in effect converts precision-recall to a single measure for each user, can then be used to locate the best point at which to operate on the curve.

Comparative Effectiveness of the Indexings Resulting From the Quartile Deletions

One might have expected, from the earlier discussion of narrow terms, that the deletion of 4th quartile terms would give the operating curve closest to the leftmost corner of the graph indicating poorest retrieval. Actually it appears that at the three middle cutoff points the deletion of 3rd quartile terms most adversely affects retrieval results, with the 4th quartile deletion running a close second. This would suggest that, on the average, the deletion of terms occurring between 5 and 13 times improves indexing most and that therefore upper and lower limits can be placed on breadth. But it would be wrong to say generally that there is an optimal breadth which is between 5 and 13 postings per term. This is not demonstrable at either end of the spray of operating curves. Actually as far as precision alone is concerned, there is no difference between deleting 2nd and 3rd quartile terms, or 3rd and 4th, or even 2nd and 4th quartile terms at any cutoff point. Only the deletion of broad terms (1st quartile) gives results that are significant. Also for recall, the deletion of broad terms results in retrieval performance significantly different from that of any other deletion, with the minor exceptions of 2nd quartile deletions at cutoffs 1 and 4. While again, for recall as well as for precision, 2nd and 3rd quartile deletions give significantly indistinguishable results. What is warranted by the data is that when a user wishes to maximize recall, the most important terms are the broader ones. If precision is desired,

these terms are not so important and infrequent terms seem most effective.

The Effect on Expected Search Length of Deleting Broad and Narrow Terms

The retrieval results evaluated in terms of Expected Search Length are somewhat simpler to analyze in that esl is a single measure of retrieval effectiveness and the results have a slightly different aspect. These results are shown in Tables 7,8 and 9 and in Fig. 4. It can be seen that, with two exceptions only, the deletion of index terms from documents results in larger esl values (poorer performance). The general tendency can be explained by the rationale that the more index terms that are assigned to documents the more information is conveyed by the indexing and the greater the organizing potential of the indexings. Thus the better the retrieval results. This rationale, which incidently is an argument for broad as well as deep indexing, will be discussed more fully below -- it needs qualification (see pp. 127 ff.).

Considering that the deletion of index terms generally results in poorer performance, one can ask whether it is possible to find terms, broad or narrow, which when deleted more seriously than others impair retrieval results. The inference is that these terms contribute most to effective retrieval. Somewhat surprisingly perhaps, it can be seen that the deviation from the no-deletion case which is most often significant is attributable to the deletion of 2nd quartile terms, those occurring between 13 and 42 times. For three out of the 5 possible s* values, the deletion of 2nd quartile terms gives the largest esl values, and moreover,

values that are significantly different from the corresponding values in the no-deletion case, in the case when 4th quartile terms are deleted and with one exception, ($s^*=3$), when 1st quartile terms are deleted. The surprise comes from contrasting this result with the precision-recall result where it is the 3rd quartile terms, not 2nd quartile terms, which when deleted give on the average the poorest operating curve. Third quartile deletion, when the esl measure is used, gives significantly poorer values in two out of the five possible cases.

This discrepancy, however, is not really serious. First, it seems one might have expected two different effectiveness measures, even though "roughly" equivalent, to give somewhat different retrieval evaluations -- analogously, as two different maps, a geological map and a highway map present somewhat different aspects of the same terrain.[1] Secondly, the discrepancy is actually insignificant. It was mentioned that as regards precision and recall there is no difference whatsoever -- at any cutoff -- between indexings with 2nd and 3rd quartile terms deleted. Similarly for esl, there is no significant difference at any s^*

---

[1]One can speculate on the nature or extent of the relationship between the two measures: while it is easy to see a rough correspondence, the question is not easy how <u>exactly</u> is precision-recall related to esl. Also of speculative interest is the relationship between a measure and what is measured, between a map and what is mapped. It can be asked how well either measure really reflects user satisfaction as regards the utility of what is retrieved. The questions are philosophic, foundational questions. The second is especially important in that any conclusions that are drawn using one of the measures are qualified in a rather basic way by not having an answer to the question "how do we know we are measuring the right thing?"

when terms of either these middle breadths are deleted.

On the average the deletion of 2nd and 3rd quartile terms causes about a 40% increase in esl. A similar increase in average esl results when broad (1st quartile) terms are deleted. From the point of view of averages, it would seem that an argument could be made that the main variable affecting esl is the number of terms posted -- whether the terms posted happen to be broad or narrow is relatively unimportant. Controverting evidence, however, is given by the deletion of 4th quartile terms, and even by the deletion of the 1st quartile terms themselves. The deletion of the narrow 4th quartile terms results in only an 8% average increase in esl, as compared with the 40% increase that comes from the deletion of terms in other quartiles. Moreover, when narrow terms are deleted, the change in esl is uniformly slight at every value of $s^* > 1$. At $s^*=1$ the change is significant, but barely so. The implication is that narrow terms, those posted less than 5 times, are not as effective in retrieving relevant documents as terms more frequently posted. This result agrees fairly well with the corresponding precision-recall result. It was seen that the deletion of 4th quartile terms makes virtually no difference in precision or recall values at low cutoff levels. At high cutoff levels there was a significant difference in recall, but not for precision. As for broad terms: averaged over all s^*, the increase in esl resulting from the deletion of 1st quartile terms differs little from the average increase for other deletions. However, unlike other deletions, the deletion of broad terms gives dramatically different results for different

s* values. When s* is small (s* = 1,2) the deletion of broad terms actually improves esl. However, the improvement in esl is not large enough to be significant, and must therefore be considered as no more than random fluctuation.[1] On the other hand, where s* is large (s* = 5), the deletion of broad terms results percentagewise in a larger increase in esl than any other deletion case (57%). This extreme figure at s* = 5 counterweights the "anomolous" figures at s* = 1 and s* = 2, and the rather small deviation for middle values of s*, making thus the average esl for 1st quartile deletions approximately equal to the average esl for 2nd and 3rd quartile deletions.

A request for many relevant documents is the esl situation

[1]It could be asked how esl could improve at all with the deletion of terms. (Analogously how could precision decrease at all with the deletion of terms, and the consequent drop in recall.) An example can be given to show that, given a small s* and the deletion of broad (not narrow) terms, it is not improbable that esl decreases. Assume that, before as well as after deletion, a request for one document is satisfied at the topmost level of the documents ranked by overlap. This assumption is a fairly reasonable one since this topmost level is densely populated with relevant documents to begin with, and, inasmuch as precision increases, becomes even more so when broad terms are deleted. Esl in the two cases is roughly proportional to the ratio of irrelevant to relevant documents (esl = $\frac{i}{r+1}$), that is, esl is roughly inversely proportional to precision. Precision increases with the deletion of broad terms, and esl therefore decreases. This is a possibility only -- esl of course does not decrease if no relevant documents are retrieved at the topmost level after deletion. However, the chance of this happening is probably negligible -- from the above assumption. To show analytically, in the form of a theoretical proof, that it is either probable or improbable that esl decreases for s* would seem to be unmanageable. All possible alternatives would have to be taken into account -- requests might be satisfied at any overlap level and the level of satisfaction need not be the same before and after deletion. Moreover, it is not clear what the result would mean since it would have to be expressed in terms of expected Expected Search Length.

that roughly corresponds to the precision-recall situation where retrieval is performed at low cutoff points; a request for a few documents is the situation corresponding to a search performed at a high cutoff level. The data shows that this tendency for small requests to be satisfied at high overlap levels and for large requests to be satisfied at lower levels becomes exaggerated when broad terms are deleted from the indexing of documents. Before the deletion of broad terms the average level at which a request for 5 documents is satisfied is the two overlap level. But after deletion, for nearly half of the requests, the search must proceed down into the rather vast 0 overlap level (which is true for none of the potentially satisfiable 5 document requests before deletion). By contrast the average level at which a small request -- a request for 1 document -- is satisfied before the deletion of broad terms is the 4 overlap level, after deletion the 3 overlap level.

Indexing With Title and Weighted-10 Terms

Depth, Breadth and Posting Statistics

In the second stage of the experiment there were four deletions of index terms from documents: all index terms not also occurring in the title of the document were deleted and the same number of terms was randomly deleted; index terms that were not given a weight of 10 were deleted and the same number of terms was randomly deleted. The depth, breadth and posting statistics for these deletions are shown in Table 10. It can be seen from

the Table that approximately 20% of the index terms assigned to a document also occur in the document title; and approximately 22% of the originally assigned terms are given a weight of 10. The average breadth of indexing after the deletions comes to less than one occurrence per document. This is because so many terms, upon deletion, lose all their postings -- the total vocabulary size, however, remains unchanged.[1] It can be seen that when the deletion of terms is systematic (the deletions of non-title and non-weighted-10 terms) the average breadth of deleted terms is 6.49, whereas when the same number of postings per document are deleted randomly, the average breadth of the deleted terms is 7.23. The implication is that index terms which are also weighted-10 terms or title terms are generally broader than terms randomly sampled, but not greatly so.

Tables 11 - 15 and Figs. 5 and 6 show the precision-recall and esl evaluations of the indexings after each of the four deletions. As before, certain of the precision values at the higher coordination levels had to be discounted because not enough documents were retrieved after the term deletions to warrant comparison with the no-deletion case. In addition to statistically comparing precision, recall and esl values for the altered indexing with the corresponding values in the no-deletion case, comparisons were made between paired random and nonrandom values for indexings of like breadth and depth. For instance, for a given s*

[1]It will be remembered that $\overline{BV} = \overline{DN}$. See p. 59.

the value after title-term deletion is compared to a value resulting from a "comparable" random deletion.[1]

Weighted-10 Indexing

Weighted-10 indexing, the indexing that results when terms not assigned this highest weight in the original indexing are deleted, gives results poorer than the original indexing, and not significantly better than random indexing with the same number of terms. At low values of s* the difference in esl from the no-deletion case was .05 significant; at higher s* values the poorer performance of weighted-10 indexing was even more significant (.01). Moreover, in no case (at no s* value) did indexing with weighted-10 terms differ at a .01 significance level from the corresponding random indexing. Precision-recall results for weighted-10 indexing, when compared to the esl results, are somewhat surprising. They support the esl results in that when weighted-10 indexing was compared with a random indexing of the same depth, there was no case in which the difference in precision was .01 significant, and in only one case was the difference in recall as significant as this. In view of these indications so far of the inferior quality of weighted-10 indexing, it comes as some surprise to see that the precision-recall operating curves show that weighted-10 indexing is essentially better than the full unaltered indexing at cutoff points 3,4 and 5. This result is not even roughly reflected by

[1] In the Tables brackets are put around paired values that differed significantly.

the esl results for low s* values. In attempting to explain what seems like a contradiction, one might resort to the assumption that the crossing of the precision-recall curves for weighted-10 and no-deletion indexing was due only to random fluctuation. It should be pointed out that the problem of small sample size was particularly acute for the precision measurements on weighted-10 indexing at cutoffs 3,4 and 5. The sample sizes at these points were 11, 6 and 2 respectively -- which in any case seems reason enough to discount the precision values at these points, _viz._, the precision values that effect the crossing of the operating curves.

The case for weighted-10 indexing seems then generally bad. One might conclude at the "semantic quality" of weighted-10 indexing is suspect. That is, among the non-weighted-10 terms removed in the deletion process there were terms important in the retrieval of relevant documents. Alternatively one might conclude that because so many terms were removed in the deletion process (average depth was reduced from 34.5 to 7.4), regardless of the quality of the weighted-10 terms left on the documents, retrieval effectiveness would have been seriously impaired. This second alternative can be rejected in light of the results for title-term indexing, also at a small average indexing depth (see p. 119 ff.). Weighted-10 indexing then must be judged as poor quality indexing. In attempting to understand why, the method by which weights were assigned to index terms by the Cranfield indexers might be reviewed. For at least 80% of the 1400-document col-

lection weights were assigned to terms on a subjective basis.[1] To receive a weight of 10 an index term had to be considered "potent" -- "potent" meaning "concepts in the main general theme of the document."[2] Also there were other conditions to be satisfied, i.e., not all potent terms were given a weight of 10. If the terms were very common (i.e., broad) or very vague (eg. "data") they were weighted less. Thus among the non-weighted-10 terms that were deleted were potent terms that were fairly broad and vague. From the point of view of the present experiment the Cranfield decision to exclude broad and vague terms from the highest importance category was not a good move. As a consequence statistics and semantics are confused, the variables are muddied. As was seen the deletion of broad terms can improve retrieval effectiveness in the high precision regions and detract from it in the high recall regions. Obviously then, the exclusion of broad and vague terms from the weighted-10 category had the effect of overvaluing "potent" indexing in the high precision regions and at low values of s*, and devaluing it in the high recall regions and at high values of s*. It might be noted that even the tampered weighted-10 indexing did not perform as well as the indexing from which the 1st quartile (broad) terms were deleted. The two indexings are incomparable in the sense that the average depth and breadth of the indexings are not the same. Still the Cranfield

---

[1] Cleverdon, Mills and Keen, <u>Factors Determining the Performance of Indexing Systems</u>, p. 55.

[2] <u>Ibid</u>., p. 55.

policy of weighting terms might be questioned.[1] Presumably a costly, time consuming and essentially intellectual operation, the weighting of terms, at least as was done at Cranfield, does not compare favorably with the essentially mechanical operation of not indexing with broad terms. This is perhaps the firmest conclusion that can be wrenched from the data, considering the confusion of mixed variables worse compounded by the discrepancy between esl and precision-recall values. The case for weighted-10 indexing neither supports nor counters the hypothesis that two indexings of comparable breadth differ in retrieval effectiveness because one consists of quality terms and the other does not.

Title-Term Indexing

The results for title-term indexing are more interesting. There were three cases where the deletion of non-title terms made no significant (.01) change in esl values. These were at s* = 1,2, and 3. In one of these cases (s* = 2) the esl value actually improved after the terms were deleted, though admittedly the improvement was quite insignificant, a drop from 11.76 to 11.60. At s* = 4 the change in esl was significant, but only at the .05 level, i.e., not at .01. At s* = 5 the change was significant at .01. The implication is that if a request is for only a few rele-

---

[1]Salton finds that weighted word stems extracted from document abstracts are clearly more effective than non-weighted stems (see Salton, "Computer Evaluation of Indexing and Text Processing," p. 24). However, he used automatic weighting methods rather than the weights assigned by the Cranfield indexers, those representing intuitive assessments of semantic relevance.

vant documents, it is unnecessary to index as deeply as 34 terms per document -- seven terms would do as well, if these terms are title terms; however, if a request is for many or all relevant documents, indexing to a depth of seven terms per document is not sufficient, no matter what the quality of the terms. More terms -- more information -- is needed to partition the collection for effective retrieval.

Comparing title terms with a set of terms chosen randomly from the original indexing to a like depth (breadth), it can be seen (Table 15) that at every s* value there is a significant difference in performance. In every case, title terms are significantly (.01) better for retrieving documents relevant to the search questions. (By contrast, in no case does weighted-10 indexing give .01 significantly different esl values than random indexing of the same depth.)

Evaluation in terms of precision and recall shows that at the higher cutoff levels (roughly corresponding to low values of s*) the operating curve for title-term indexing is better than the curve for the no-deletion case. Also corroborative of the esl results for title-term indexing is the precision-recall performance of title terms compared with a random sample of terms chosen from the full indexing to a comparable depth. At every cutoff value the difference in recall between the two indexings is .01 significant. The difference in precision, however, is as significant as this at only one cutoff point (cutoff 1) but at another (cutoff 3) it is .05 significant. (By contrast weighted-10 index-

ing compared with the corresponding random indexing showed a .01 significant difference in precision in no case, and in recall in only one case.)

If the average breadth (depth) of indexing were the main variable affecting retrieval performance, one would expect similar effects whether terms were deleted randomly or on purpose. The hypothesis might be stated that particular words in themselves are not important, more important is the actual number of words chosen to index the documents. The results for title-term indexing in the high precision, low s* regions constitute a counterinstance to this hypothesis. It would seem that title terms are quality terms in the sense that they are especially effective in retrieving relevant documents. From this one might infer that there is a correlation between the title of a document relevant to a given question and the fact of its relevance. There is a difficulty here however. It is not clear that the correlation is a real one. It is real only if there is no <u>unnatural</u> bias between a question and the title of a relevant document. An unnatural bias might come about if, for instance, in the original assessments of relevance, some relevant documents, perhaps those with unobvious titles, were overlooked. Very likely this is what happened. The fact that students did the searching for relevant documents, and no doubt their attention was flagged by noticeable titles, makes it probable. Cleverdon was concerned about the problem of unnatural bias and in an attempt to determine whether one existed he examined some of the search questions together with their relevant docu-

ments. He found that nearly 1/3 of the questions had a strong question-title match.[1] But the figure of 1/3 can neither prove nor disprove the existence of an unnatural bias. Cleverdon's words are more persuasive: "one would have expected a certain strength of title match in this subject, where titles are usually fairly long and a good indication of the subject of the document,"[2] and "it is wrong to conclude . . . that whenever there is a substantial match between question and title, then the relationship is necessarily unnatural."[3] This seems fair and Cleverdon admits that nothing conclusive can be said on the subject of a title-question bias until questions are obtained from a real life situation and tested in an existing collection. Indeed one might speculate that many "real life" questions are really searches for partially remembered titles, in which case the correlation between question and relevant-document title would be strong and natural. As regards the results of the present experiment, however, it needs and perhaps suffices to be said that they are limited by the assumption of no unnatural title-question correlation.[4]

---

[1]Cleverdon, Mills and Keen, Factors Determining the Performance of Indexing Systems, Vol. 1, 38.

[2]Loc. cit.

[3]Cleverdon, Mills and Keen, Factors Determining the Performance of Indexing Systems, Vol. 1, 36.

[4]Salton's results for title-term indexing using this data might be mentioned. Salton compared the automatic indexing of titles with the indexing of abstracts, also done automatically. He finds the abstract process to be superior to the title-only option. This result, while important from the point of view of the feasibility of machine indexing, does not say much one way or

the other about the special usefulness of words which occur in titles. This is because the titles were indexed to an average depth of 11 descriptors, while the abstracts were indexed to the much greater (average) depth of 91; so what Salton shows is that with 91 descriptors mechanically derived from an abstract it is possible to achieve better results than with 11 descriptors mechanically derived from a title. It seems quite possible that the superior performance of abstract indexing can be accounted for by the greater "depth" of indexing. At least there is reasonable doubt that Salton's experiment demonstrates anything conclusive about the innate value of the particular words used in indexing.

CHAPTER IV

CONCLUSION

The Case for Specific Indexing

The main purpose of the experiment was to answer the question which term functions most effectively in the retrieval of relevant documents, broad or narrow. The answer, as has been seen, is not straightforward, but depends upon what the user of the retrieval system wants, his wants being expressed in terms of a stated precision-recall preference, or, more precisely, by the exact number of relevant documents he wishes to retrieve. This result is not unexpected. At the end of the last century Cutter advised that the principle of specific entry be viewed in light of another principle, *viz*., the usage principle. Over the years there has perhaps been too much concern about the "language" of the users, at least the present study shows that an important operational factor is the user's quantitative needs. Some insight into the nature of the relationship between indexing specificity and user needs can be given by summarizing the experimental results as they bear on indexing with narrow (specific) terms.

The deletion of narrow terms (1-5 postings per term) affects recall less than the deletion of broad terms. Precision is *never*

improved by deleting narrow terms. When retrieval is performed at high coordination levels (in the present study at coordination levels greater than 2), the deletion of narrow terms adversely affects retrieval output with respect to precision, as well as recall. Even the deletion of relatively narrow terms (5-13 postings per term) decreases precision at these levels. By contrast, the deletion of broad terms improves precision, at any coordination level, and the operating curve for the deletion of broad terms is better than the curve for the no-deletion case at coordination levels greater than 2. The quality of retrieval in either precision or recall is not affected when narrow terms are deleted at low coordination levels, at cutoffs of 1 and 2. Narrow terms, while important where high precision is desired, are redundant and unnecessary when the demand is for high recall. Retrieval evaluation measured in terms of esl generally supports these conclusions. The deletion of narrow terms does not affect esl values significantly except at the lowest request level where the user wants only one relevant document, in effect where the user wants high precision.

An argument can be made for the "importance" of narrow terms in indexing for quality retrieval. What happens as the cutoff point is raised is that the retrieval power of broad and narrow terms becomes equalized, that is, the difference between the number of documents a term brings in becomes obscured, while the difference in the quality of the retrieved documents with respect to relevances becomes more apparent. The fact that at higher coordi-

nation levels the deletion of narrow terms makes for worse precision as well as worse recall suggests that the documents retrieved by narrow terms are more likely to be relevant than those retrieved by broad terms. This difference between the retrieval effectiveness of broad and narrow terms is not fully explainable on the basis of the relative sizes of the document sets retrieved, since, in its demonstration, the tradeoff hypothesis was violated. In other words, narrow terms are essentially good index terms, and not just apparently so by virtue of statistical accident.

The argument for narrow terms must, however, be qualified. There are cases where index terms can be too narrow. If a user is interested in high recall or needs more than one relevant document, narrow terms, though "quality" terms, are ineffectual, the work of retrieval depending on broad terms. It was shown that on the average -- i.e., averaged over different request sizes and different cutoff values -- index terms that are posted between 5 and 32 times are "optimal" judging by the effect of their absence on retrieval performance. One is reminded of Pettee's "guess" of "less than a dozen" postings per term as the lower limit on specificity.[1] It is misleading, however, to speak of index terms of "optimal breadth," since the best breadth of term is a variable -- it varies with the user's decision as to the number of relevant documents he needs or the number of irrelevant documents he can tolerate. Lilley's answer to the question "How specific is 'specific'?" is

---

[1]See p. 22.

sound. "Well, it all depends!"[1] But the answer was left hanging. Lilley does allow it depends on user's needs, but intangibly so: "Specificity may be so intangible as to be nothing more in an effective sense than a chance relationship between the user's need of the moment and the format of a particular book an individual library happens to own."[2] Specificity need not be chancy or intangible when user's needs are interpreted in terms of a precision-recall preference or the number of documents desired.

The Case for Indexing in Depth

The second purpose of the experiment was to examine the question how important a factor in retrieval effectiveness is average breadth or depth of indexing. It was speculated that perhaps the quality of particular index terms was more significant in the retrieval of relevant documents than statistical properties of the indexing such as the number of index terms assigned to a document or the number of different terms used in indexing the collection. The experimental results that are most interestingly relevant to this question are those for title-term indexing. It was seen that when only one or two documents on a topic were requested, indexing with seven terms taken from the document title, presumably seven quality terms, led to good retrieval performance: in some cases performance results were slightly better, but in no case were they significantly different than indexing with the full 34.5 terms,

[1]Lilley, "How Specific is 'Specific'? " p. 8.

[2]*Ibid*., p. 6.

including title terms, originally assigned to each document. On the other hand, when a request for four or five documents was put to the system, title-term indexing did not perform so effectively, again underlining the importance of the variable "user's needs, quantitatively expressed."

Cleverdon in the Cranfield II study experimented with title, abstract and full document indexing. In explaining the differences in the results for these three types of indexing he cites indexing depth (exhaustivity) as the "main operational variable."

> There is the possibility that the selection of terms by the indexer was more descriptive of the document content than those terms used for the titles and the abstracts, but the main variable in these five results concerns the level of indexing exhaustivity. It would seem that while the titles were at too low a level of exhaustivity (7 terms per document), the gradual increase in the level, up to an average of 33 terms, brought about an improvement in performance. However, the higher level of exhaustivity represented by the abstracts (probably about 60 terms per document) was too high, resulting in the retrieval of large numbers of additional non-relevant documents.[1]

Cleverdon's opinion might be questioned. The small difference observed between title-and full-document indexing (59.76% and 65.00% normalized recall ratios respectively) may not be statistically significant. Even if significant it seems a little surprising that so small a difference in retrieval performance can be explained by so large a difference in depth -- 7 terms per title vs. 33 terms per document. Moreover, if operational depth

---

[1]Cleverdon and Keen, Factors Determining the Performance of Indexing Systems, Vol. 2, 259.

is an important factor in retrieval performance one would expect similar effects from indexings of the same depth. But the present experiment offers a counter-instance: title-term indexing proved significantly better than the "random" indexing at a comparable depth. Cleverdon, to support his contention that depth is the main variable, observes that retrieval performance improves with the gradual increase in depth from seven terms per document up to 33 terms per document. The present experiment shows that title-term indexing at an average depth of seven terms per document gives a better precision-recall operating curve than some indexings of 25 terms per document (when the quartile deletions were made). The expression "the main variable" seems somewhat incautiously used. Clearly retrieval performance is a function of the quality of the index terms assigned to a document as well as their quantity. On the other hand, it cannot be denied that the weakness of title-term indexing is its lack of depth. As was seen, this is especially apparent when the number of documents requested of the system is large, when high recall is desired. The first person to make a principle of title-term indexing realized its weakness. Crestadoro in his Manchester Catalog, a concordance of titles, warns his users that in using the catalog some "relevant" items will be missed: "under any given subject the whole of the books . . . are not brought together, but only those in which the name of the subject occurs in the title."[1] Of course, Metcalfe regards

[1] Quoted in Metcalfe, Information Indexing, p. 48.

the weakness as fatal and insists that title-term indexing is a delusion, which, while he can understand why it may have arisen, he fails to see why it persists.[1] It perhaps has as much reason for persisting as "specific" indexing. Either indexing seems adequate for retrieval situations in which completeness of recall is not necessary, or, for economic reasons, not possible. Situations where not all relevant documents on a subject are needed allow for compromise -- the number of documents that can be retrieved on a title basis may be all that is required.

The fact that the "weakness" of title-term indexing is its lack of depth raises the question whether there is an optimal average depth (or breadth) of indexing. The data seems to warrant the opinion that, for the most part, the deletion of terms from documents affects retrieval performance adversely. This seems especially true when performance is measured in terms of esl. It might be said to be qualifiedly true when the precision-recall measure is used, in the sense that the better results obtained by the deletion of terms are not always credible since they occur at high cutoff levels where the sample size is usually small. One might hypothesize that the indexing of documents should be as deep (broad) as possible, and examine the hypothesis for its plausibility.

To support the hypothesis an example can be given, illustrating that even the addition of a synonomous term to the indexing of a document could improve retrieval performance. Let $s^* = 3$ and

[1] Ibid., p. 49.

assume the following two-level ordering, the first (case 1) having the document indexed without the synonomous term, case 2 with the synonomous term:

2 overlaps	Case 1	00●0●	Case 2	●0●0●0
1 overlap		00000●		00000

Assume also that the question, either by the user or by the system via a thesaurus, is indexed with the two synonomous terms. In this case then the addition of the synonomous term to the document indexing has the effect of giving a relevant document an additional overlap with the question (case 2). Esl in the second case is 2.25; in the first case, before the addition of the synonomous term, it is 7.5. However, theoretically it can be argued that there is an upper limit on this redundancy effect, i.e., there is an upper limit to the number of terms which optimally should be assigned to a document. One can imagine an extreme case where the indexing is as deep as vocabulary size permits, where each document is indexed by every term on the indexing vocabulary. In this extreme and limiting case the document collection would be as unstructured and disordered as had there been no index terms assigned at all. In either case the collection would be searched for relevant documents, as though at random, the only difference being that in the one case all documents are collected at the highest overlap category and in the other at the 0 overlap category. Neither way is the indexing discriminating or informative. It is possible then, to index so deeply as to get no information at all about which documents are relevant to which questions. Hypothetically at least,

esl need not increase with the deletion of index terms. On the other hand, though the point of effective redundancy in indexing can be over-reached,[1] it would seem that the content of the documents being indexed, as well as language itself, would set a natural limit on possible redundancy far below this limit.

The operational imperative suggested by the foregoing is to index as deeply as semantic meaning will allow. But this is speculation only. Nothing in the experiment really justifies a statement about an upper depth limit, since the experiment was restricted by the number of terms originally assigned to the documents (on the average 35). It might be suggested that the experimental results indicate a practical limit to indexing depth, in

[1]The question about the amount of redundancy needed in indexing can be regarded as a question about the distribution of index terms. In the literature it has been suggested that the most informative distribution of index terms is the one that makes for the most uncertainty about the number of postings any given terms will have (see Pranas Zunde and Vladimir Slamecka, "Distribution of Indexing Terms for Maximum Efficiency of Information Transmission," American Documentation, XVIII, (April 1967), 104). It is not clear. In fact, it is unlikely that semantics can be so easily dismissed. Perhaps the truest thing that can be said is only tautological: what makes indexing informative is its discriminating power, its ability to structure the collection in such a way that it is easier to retrieve relevant documents than irrelevant ones. Conceivably the collection should be structured differently depending on whether requests for relevant documents are small or large. One might say, with regard to the example above, that of a single document request, that the structuring of the collection is overinformative, the high overlap levels being too rich in relevant documents so that esl could be improved by term deletion. It could be regarded as underinformative when the number of documents requested is much larger than the number retrieved at any overlap level above 0. In any case it does not seem that optimal or normative index term distribution can be discovered by statistical information theory (Zunde and Slamecka) or, for that matter, by a descriptive or mathematical analysis of how index terms are actually distributed (Wall). In some manner questions about the depth, breadth and distribution of index terms must be related to measures of retrieval effectiveness.

the sense of diminishing returns; if the deletion of terms does not give performance values which are significantly worse, the cost of assigning these terms at the time of the original indexing is not really justified. The esl results show that for any size request at least one quartile of the index terms assigned to documents do not contribute significantly to effective retrieval. Unfortunately it is not always the same 25% of the postings which are superfluous.

Practical Implications

Library practice over the years has attempted to reach a compromise between good precision and good recall. It will be remembered that it was the lack of precision in retrieval output that first title-term indexing and then the alphabetical catalog with its specific entry principle was intended to remedy. Consciously and perhaps unconsciously there has been an unwillingness to compromise. Unconsciously in that there seems to be an attempt to obey two conflicting imperatives: to bring all books on a subject together[1] (recall) and to index as specifically as possible (precision). One can read this conflict in the history of the controversy over alphabetical and classified catalogs. Unwillingness to compromise is also represented in the conscious opposition to the principle of double entry,[2] of having both broad and narrow terms

[1]See for instance Metcalfe, Information Indexing, p. 48.

[2]See the discussion beginning on p. 19.

to serve both sorts of users, those wishing completeness, and those needing only a few relevant documents. The main argument against using double entries has been that the catalog would be burgeoned with an unwieldy reference apparatus disproportionate to the number of actual items processed. A more persuasive argument against,perhaps,is the cost and time required by comprehensive indexing, when budgets and personnel are limited.

A corollary result of the precision-recall evaluation of broad and narrow terms is that a method is given for determining the relative effectiveness of the two precision devices: raising the cutoff point and deleting broad terms. For the collection studied, raising the cutoff point (making the search more exhaustive) is more effective until cutoff 3 is reached, at which point the best means to precision is to delete the broadest terms assigned to the documents (making the search more specific). This is an interesting result and if generalizable could have practical implications for libraries of the future. Ideally libraries should be able to accommodate request of any recall-precision requirement; in terms of esl, requests of any size. Documents should be indexed with broad terms to satisfy recall preferences, with narrow terms to satisfy precision preferences. It has been suggested[1] that indexing with narrow terms (as specifically as possible) would be sufficient, since one can always "explode" on these terms -- presumably via a thesaurus or classified schedule be led to the

[1]See F.W. Lancaster, "MEDLARS: Report on the Evaluation of Its Operating Efficiency," American Documentation, XX, (April 1969), 131.

appropriate broad terms quite automatically. This perhaps shows an overassuming confidence in the simplicity of language structure as represented in thesauri. In any case it requires less assumption about the exploding possibilities in language to say that documents should be indexed with broad and narrow terms, and as deeply as possible up to the limit imposed by semantic common sense. It need not be said of an index language that it is too exhaustive, that there are too many "concepts" indexed; or that it is too specific -- in an ideal system at least, a narrow term does not preclude a broad term also being assigned. If retrieval values should be poor, it can always be argued that the fault lies not in the indexing but in the search strategy used. An ideal system allows the possibility of custom retrieval, of indexing that can be adjusted to every user's need, simply by varying search strategy. From the point of view of precision-recall, a search can be varied by deleting broad or narrow terms, or by changing the cutoff condition required by retrieval. The operating curves of a system prescribe a search strategy for each individual user, once he has decided on the particular balance he wishes maintained between precision and recall. From the point of view of esl, this balance is, in effect, achieved by specifying the number of relevant documents requested of the system -- this is part of "search strategy." In either case, whether the effectiveness of a retrieval system is measured in terms of precision-recall or esl, it would seem that, ideally at least, the best indexing is an indexing which is potentially all possible indexings and which, as part

of a clearly explicated search strategy, is realized as a particular indexing, broad or narrow, as the case requires. Thus, it is not a question of deciding in the abstract which method of indexing is "best," but of giving the user at the time of search the option of tailoring the indexing to his needs.

Indexing as deeply and broadly as document content permits is perhaps rather much of a theoretical luxury. From the point of view of traditional indexing practices it would be out of the question. Indexing depth, where specified at all, has been determined not by theoretical considerations but by policies dictated by cost and the practicality of catalog size. It is not likely that economic problems will vanish. Conceivably, automatic indexing procedures will be developed that will make the ideal of comprehensive indexing realizable. There are difficult problems in this area, however: problems in semantics, similar to those besetting mechanical translation, and problems in the technology of developing optical scanning devices. The old question of burgeoning a catalog with too many entries can be reformulated as a question of burgeoning a computer memory. Problems of file structure and search codes are exceedingly complex and mind-boggling. It would be surprising, for instance, if an optimum file structure (ordering of entries) is less elusive a goal than a single optimum breadth or depth of indexing. Ideally, entries in a file should be ordered differently for each request to make possible a systematic search for relevant documents. The number of entries in a file such as the catalog of a large university library can easily run

into the millions. As yet it is economically unthinkable that all entries in this file could be weakly ordered according to overlap each time a new question is to be searched. It rather seems as though it will be awhile before the time is ripe for personalized retrieval, in which case the need for compromise still exists. The present study, while it suggests an operational rule for specification indexing for ideal libraries of the future, is not in itself sufficient to deal with the present and real problem of compromise which faces libraries today. What is needed in addition to such a study is information about user preference, for example a preference for precision over recall (or vice-versa); or, in the case of esl, a preference expressed in terms of the number of documents needed to satisfy a request. The difficulty here is in trying to approximate what perhaps does not exist, viz., a typical or average request for information.

Summary

By way of conclusion, certain limitations of the present study can be mentioned. They have been referred to in the text, and can be expressed here in the form of unknowns: 1) not knowing the effect on retrieval performance of the subject matter of the test collection, p. 73; 2) not knowing whether the sample size is large enough or sufficiently random to yield generalizable results, p. 78; 3) not knowing, with statistical certainty, the behavior of precision at high coordination levels, p. 99; 4) not knowing whether the coordination between questions and the titles

of documents relevant to these questions reflects a bias one might expect to find in actual non-experimental retrieval situations, p. 121 ff.; 5) not knowing what a "typical" question or search request is, p. 137.

It might be said that to a certain extent the experimental results are circular in nature. The specificity or breadth of a term is defined as the number of documents indexed by the term; and retrieval effectiveness is evaluated with respect to the number of relevant documents a user wants or the number of irrelevant ones he will tolerate. There are, however, certain findings of the experiment that are not obvious: 1) deleting narrow terms never improves precision -- a counterinstance to the tradeoff hypothesis, in that deleting narrow terms can make both precision and recall worse; 2) the dichotomy between improving precision by indexing with narrow terms or by using broad terms and raising the cutoff point is a false one -- narrow terms are more effective as retrieval hooks at high cutoff levels than they are at low levels where, in fact, they are redundant; 3) the deletion of broad terms is in some instances a better means for improving precision than raising the cutoff point.

The significance of the present study lies in its being an attempt to use objective criteria for evaluating the "goodness" of indexing in terms of its specificity. Specificity, as a factor in indexing, has been considered important since the middle of the last century, yet till now there has been only speculation, combined though with firm conviction, about its certain usefulness

and uncertain meaning. The designing of the experiment to study the effect of varying levels of specificity on retrieval performance has forced an explicit definition of "specificity" and has required an examination of specificity in its interrelatedness with other factors affecting retrieval performance. I would like to regard the study more as a method of historical and experimental analysis than as an attempt to provide operational answers -- it would have been surprising if there were easy answers. Qualifiedly then, the findings of the experiment may be summarized the following way:

1. The amount of material retrieved in a system is not a simple function of the total number of terms posted to documents in the collection. This is perhaps obvious, but it is useful in explaining why the quantity and quality of retrieval can vary considerably for collections having the same number of total term postings, in effect the same average indexing depth. Important also is the number of <u>different</u> terms posted. This is evidenced by the results for indexings of like depth that show different retrieval behavior depending on how terms were deleted from documents: whether many infrequent terms were deleted or a few broad terms were deleted.

2. At high cutoff values the retrieval power of broad and narrow terms tends to become equalized. The stricter retrieval condition at high cutoffs -- eg., a document must have five overlaps in common with a document to be considered "retrieved" -- has the effect of constraining the amount of material any single term,

especially broad terms, can retrieve. Where the cooperative strength of several terms is required for retrieval, the existence of narrow terms on documents becomes important. On the other hand, at low cutoff values, narrow terms appear to be redundant in that the broad terms cover so many documents -- eg., flow which indexes 75% of the collection -- it is unlikely that a narrow or infrequently used term could bring in something new.

3. At higher coordination levels, i.e., when precision is desired, narrow indexing is preferable to broad indexing. At these levels the removal of broad terms from the document indexing improves the quality of the retrieval output as seen from the operating curves for the various indexings, while the removal of narrow terms affects both recall and precision adversely. At lower coordination levels, i.e., where recall is maximized, the amount of retrieved material is so overwhelming that narrow terms are redundant and insignificant in effect. The removal of broad terms, while stemming the flood, is not as effective a measure for reducing the amount of irrelevant material retrieved as raising the cutoff point. What is most obvious in the data is that optimal breadth (and optimal depth as well) seem to be variables depending on cutoff point, ultimately on users' preference for precision or recall.

4. The deletion of index terms from documents generally impairs retrieval performance when measured by esi. On the whole relatively broad terms, terms occurring in the 2nd quartile (those posted 13 to 32 times), have the most power to retrieve

relevant documents, as measured by the increase in esl when these terms are deleted from the indexing. Fourth quartile terms, those used most infrequently, are not especially effective in retrieving relevant documents and for requests for more than one document they can be dispensed with without causing significantly lower esl values. The broadest terms are important retrieval hooks when the number of documents requested by the user is fairly large; they are not significantly important when the number of documents requested is small. As was seen in the case of precision and recall, what is "optimally" the best breadth of term is a variable -- it varies with cutoff point and the user's decision as to how much irrelevancy he can tolerate. When retrieval effectiveness is measured in terms of esl, optimal breadth varies according to the number of relevant documents the user wishes to retrieve from the system.

5. The operating curves for precision-recall show the relative usefulness of the two devices for improving precision: raising the cutoff point and deleting broad terms. This is presumably something that will differ from collection to collection. For the Cranfield II data, raising the cutoff is a better method for reducing the amount of irrelevant material retrieved until a cutoff of 3 is reached. After this "critical value," the more efficient method for improving precision is to delete broad terms.

6. The results for highly weighted indexing are disappointing. Indexing with the subset of weighted-10 index terms, those judged most highly descriptive of the text, resulted in significantly poorer retrieval performance than indexing with the full

set of originally assigned terms. This was true for performance measured in terms of precision-recall at low cutoff points and when the esl measure was used, for all s* values. Moreover, indexing with weighted-10 terms differed insignificantly, in retrieval results produced, from indexing with a subset of the same number of terms chosen at random from the original indexing. In fact, it appeared that better retrieval performance could be achieved by mechanically deleting the most frequent terms from the original set of terms than by conscientiously selecting out seemingly "unimportant" terms. However, a conclusion that a policy of weighting terms is not efficient should be suspended; it is possible that the fault is peculiar to this experiment and lies in the Cranfield II rules for weighting terms, especially the rule that says broad and vague terms should be excluded from the highest weight category.

7. The results for title-term indexing are less inconclusive. At high cutoff or low s* values, indexing with seven terms taken from the title of a document resulted in retrieval performance not significantly different from that obtainable from the original document indexing consisting of five times that many terms. Moreover, there was a significant difference in performance between indexing with the same number of terms chosen randomly from the originally assigned terms. On the other hand, the limits of title-term indexing are realized in those cases where user requests are for many documents, at the high recall region of the precision-recall operating curve, at high values of s*. The title-term results, thus, qualifiedly support the hypothesis that two indexings of

comparable breadth or depth differ in retrieval effectiveness because one consists of quality terms and the other does not.

APPENDIX A

COMPLETE VOCABULARY LIST

01 abel

00 aberration

00 ablated

01 ablating

04 ablation

00 able

01 about

01 above

01 abrupt

00 absence

01 absolute

00 absorbed

01 absorption

01 accelerated

01 accelerating

05 acceleration

00 accelerators

00 accelerometer

00 acceptance

00 accidental

01 accommodation

00 accumulation

00 accuracy

01 accurate

00 acetate

00 ackeret

01 acoustic

00 acoustically

00 across

00 acting

00 action

00 activation

01 active

01 activity

01 actual

01 addition

00 additional

03 adiabatic

02 adjacent

01 adjustable

00 adjusting

00 adsorption

00 advance

00 advancing

01 adverse

00 aeolotropic

37	aerodynamic
00	aerodynamically
00	aerodynamics
00	aeroelastic
01	aeroelasticity
16	aerofoil
00	aeronautical
01	aeroplane
00	aerothermochemistry
01	aerothermodynamic
00	aerothermoelastic
00	affected
00	aft
00	after
06	afterbody
00	afterburner
00	afterburning
00	aftercooler
00	afterflow
02	ahead
01	aileron
32	air
04	aircraft
00	aircraftresearch-association
00	airflow
00	airframe
00	airjet
00	airliner
00	airload
01	airspeed
00	airstream
00	airy
00	alclad
00	alcoa
00	alden
00	alfven
00	algebraic
00	algorithm
00	aligned
00	alignment
00	all
01	allmovable
00	allmoving
00	allowable
01	alloy
00	almen
00	alone
00	along
00	alteration
01	alternating
00	alternative
16	altitude
01	aluminum
03	ambient

00	ames
00	ammonium
02	amount
00	amplification
01	amplitude
00	analogous
00	analogue
01	analogy
00	analyser
19	analysis
03	analytic
06	analytical
01	anemometer
46	angle
00	angled
00	angular
00	angularly
00	anhedral
00	anisotropy
00	annular
01	annulus
00	antenna
00	anticlastic
01	antisymmetric
00	antisymmetrical
01	apex
02	apogee
01	apparatus
01	apparent
01	appearance
00	applicability
00	application
02	applied
01	approach
01	approaching
00	appropriate
09	approximate
00	approximating
11	approximation
00	ar
08	arbitrary
06	arc
01	ardc
03	area
01	argon
00	around
01	arrangement
00	arrest
01	arrow
00	art
02	artificial
00	artificially
00	asbestos
00	ascending
00	ascent
00	asme

20	aspect
00	assessment
01	associated
00	assumed
00	assuming
00	assumption
00	astrolite
00	astrophysics
01	asymmetric
00	asymmetrical
00	asymptote
06	asymptotic
00	asymptotically
01	atlas
21	atmosphere
06	atmospheric
01	atom
02	atomic
04	attached
02	attachment
29	attack
00	attenuating
02	attenuation
00	attitude
00	audio
02	augmentation
00	aural
00	auto
00	autocorrelation
00	autocorrelogram
00	autoignition
01	automatic
01	autopilot
00	auxiliary
02	average
00	averaging
00	avoidance
01	avro
12	axial
01	axially
06	axis
06	axisymmetric
00	axisymmetrical
01	back
00	backing
00	backward
01	baffles
00	bakanov
00	bakelite
03	balance
00	ball
02	ballistic
01	ballotini
01	balsa

01 bands
00 bandwidth
01 bangbang
00 bank
00 banked
00 bar
00 bare
00 barrel
06 base
00 based
01 basic
00 batdorf
00 bays
01 bead
02 beam
00 beane
00 bearing
00 beat
00 bed
00 bedford
00 beginning
04 behavior
06 behind
00 bei
00 bell
00 belleville
00 belotserkovski
01 belt
00 bend
08 bending
01 beneath
00 ber
00 bernoulli
00 berthelot
00 bessel
00 bestfit
00 beta
02 between
00 bevelled
00 bibliography
00 biconvex
00 bifurcation
00 biharmonic
00 billowing
00 bimetallic
00 bimolecular
00 binary
00 binding
01 biot
01 biplane
01 birnbaum
00 bisector
00 bistable
00 black
13 blade

03	blading
04	blasius
00	blast
02	bleed
00	bleeding
00	block
05	blockage
00	blocking
03	blow
02	blowdown
01	blower
05	blowing
01	blown
00	blowoff
00	blowout
01	bluff
27	blunt
06	blunted
01	blunting
03	bluntness
03	boattail
00	boattailed
00	boattailing
44	body
00	boiloff
00	bolt
00	boltzmann
00	bomb
00	bomber
00	bond
00	boom
01	boost
00	booosted
00	booster
00	boosting
00	bore
00	bottom
00	boultonpaul
01	bound
73	boundary
00	bounded
00	bounding
06	bow
00	bowing
00	box
00	boxtype
01	brading
00	braking
00	brass
00	breakdown
00	breaking
01	breathing
00	bridge
00	broad

00 btu

00 bubble

00 buckle

00 buckled

01 buckling

00 budiansky

01 buffet

05 buffeting

00 built

00 bulk

00 bulkhead

02 bump

01 buoyancy

02 burned

00 burning

00 buried

00 burst

01 bursting

00 busemann

02 buzz

00 cabin

00 calculated

01 calculating

39 calculation

00 calculus

00 calibrated

00 calibration

00 caloric

00 calorically

04 camber

01 cambered

00 camera

00 can

00 canard

00 cancellation

00 canted

01 cantelever

01 cantelevered

00 cap

01 capability

01 capacitance

01 capacity

00 capillary

00 capped

00 capsule

01 capture

00 caravelle

02 carbon

00 carbonate

01 carborundum

00 caret

01 carrying

02 cascade

00 case

00 cassinian

00 castiellanos

00	castolite
00	catalytic
00	cathode
00	cauchy
00	caused
00	cavitating
00	cavitation
00	cavity
00	cell
00	cellular
00	cellulose
00	centaur
01	centering
01	centimetre
01	central
00	centrally
14	centre
00	centred
00	centreline
05	centrifugal
00	centripetal
00	ceramic
01	cessation
02	chamber
08	change
00	changing
05	channel
00	chapman
15	characteristic
00	charge
01	charged
00	charging
00	chart
04	chemical
03	chemically
00	chemisorption
00	cheng
00	chessboard
00	chien
00	chimneys
00	china
01	chloride
01	choke
05	choked
05	choking
07	chord
12	chordwise
00	chroming
00	chromium
00	cincinnatitesting-laboratorymaterial
00	circling
01	circuit
00	circuitry
18	circular
00	circularity

01	circulating
03	circulation
01	circulatory
01	circumferential
00	circumscribed
00	civil
00	clamped
00	clamping
00	clamshell
01	classical
00	classification
00	clausing
00	clay
00	climb
01	clipped
00	clockwise
00	close
03	closed
00	closely
00	closures
00	cloud
00	coaxial
01	cocurrent
00	code
50	coefficient
02	cold
00	cole
00	collapse
00	collapsing
00	collecting
00	collective
02	collision
00	collocation
00	columbium
00	column
02	combination
03	combined
00	combustible
03	combustion
00	comparison
00	compatibility
00	competition
00	complementary
05	complete
00	completion
00	complex
02	component
01	composed
01	composite
01	composition
01	compound
01	compreg
01	compressed
04	compressibility

16 compressible
00 compressing
05 compression
00 compressive
00 compressively
11 compressor
01 computation
00 computational
00 compute
03 computer
02 concave
01 concentrated
01 concentration
01 concentric
00 concept
00 conceptual
01 condensation
21 condition
01 conducting
08 conduction
00 conductive
04 conductivity
00 conductor
11 cone
00 coned
07 configuration
00 confluence
00 confluent
00 conformal
09 conical
01 conically
00 conjugate
00 connected
01 conservation
00 conservativeness
00 considerations
00 consistent
12 constant
01 constraint
00 constriction
03 construction
00 consumption
01 contact
00 containment
00 contamination
00 content
01 continuation
01 continuity
05 continuous
00 continuously
03 continuum
03 contour
00 contoured
01 contracting
06 contraction

01 contribution
20 control
00 controlled
01 controlling
00 convected
00 convecting
04 convection
04 convective
00 conventional
03 convergence
04 convergent
03 converging
00 conversion
00 convertor
03 convex
00 cool
00 coolant
01 cooled
00 cooler
04 cooling
03 coordinate
00 coplanar
02 copper
00 core
04 corner
00 cornered
01 corotating
05 correction
00 corrective
00 corrector
01 correlated
00 correlation
00 correlator
00 correlogram
00 corresponding
00 corridor
00 corrugated
00 corrugation
00 cost
02 couette
00 coulomb
00 counter
00 counteraction
01 countercurrent
01 counterrotating
00 counting
00 couple
01 coupled
00 coupling
01 coupon
00 cover
00 coverage
00 covered
00 cowling

00	crack
00	cracking
00	crank
00	creep
00	creeping
00	crest
01	criterion
02	critical
00	crocco
00	crookedness
01	cropped
05	cross
01	crossection
01	crossed
01	crossflow
01	crossing
00	crown
00	cruciform
00	cruise
01	cruising
00	crystals
00	cubic
00	cumulative
00	curling
01	current
00	curtain
00	curtis
00	curtisswright
11	curvature
08	curve
02	curved
00	curvilinear
00	cushion
00	cusp
00	cusped
00	cut
00	cutout
01	cycles
00	cyclic
00	cycling
00	cyclotron
17	cylinder
03	cylindrical
00	d-c
00	damage
00	damped
13	damping
01	dampometer
00	dashpot
12	data
00	day
01	daytime

01 daytonight

00 dead

00 debris

00 debye

00 decarburized

03 decay

01 decaying

01 decelerating

04 deceleration

00 deck

00 decomposition

00 decoupling

01 decrease

00 decreasing

00 decrement

00 deduction

00 deexcitation

00 defect

01 deficiency

00 deficit

00 deflagration

02 deflected

00 deflecting

05 deflection

00 deformable

00 deformation

00 deformed

00 deforming

00 degeneration

18 degree

00 dehoffman

00 delaval

01 delay

12 delta

00 dense

24 density

00 dependant

00 dependence

05 dependent

00 deposit

00 deposited

00 depression

00 depth

01 derivation

09 derivative

00 deryagin

00 descending

00 descent

00 description

00 descriptive

15 design

01 destabilising

00 destalling

04 detached

05	detachment
00	detection
13	determination
00	detonation
00	deuce
00	developable
02	developed
03	development
02	deviation
00	device
00	dewpoint
00	diagram
08	diameter
00	diamond
01	doaphragm
01	diatomic
00	dielectric
01	dietze
05	difference
00	different
07	differential
02	differentially
00	differing
00	diffraction
00	diffuse
01	diffuser
01	diffusion
00	diffusivity
00	digital
03	dihedral
01	dimension
00	dimensional
01	dimensionless
00	dimpling
01	dioxide
00	dirac
01	direct
00	directed
01	direction
02	directional
00	dirt
03	discharge
03	discontinuity
01	discontinuous
01	discover
01	discrete
01	disequilibrium
02	disk
00	dislocation
00	dispersed
00	dispersion
01	displaced
11	displacement
00	dissipation

01 dissipative

03 dissociated

04 dissociating

07 dissociation

00 dissolved

17 distance

00 distant

00 distorting

01 distortion

02 distributed

80 distribution

07 disturbance

03 disturbed

00 disturbing

02 diurnal

04 divergence

05 divergent

02 diverging

00 dividing

00 diving

01 division

00 doak

00 dodecagonal

01 domain

00 dome

00 donnell

00 door

00 doppler

00 dorodnitzin

03 double

02 doublet

00 down

08 downstream

00 downward

09 downwash

53 drag

01 driers

00 drift

01 drilled

01 drilling

01 drive

01 driven

00 driver

04 driving

01 droop

00 drooped

00 drosophila

00 drum

01 dry

00 dual

00 duct

00 ducted

00 ducting

01 due

00 duralumin

03 duration

00 during
00 dust
06 dynamic
00 dynamically
06 earth
00 eccentrically
06 eccentricity
00 echoes
00 eckert
00 economics
04 eddy
31 edge
08 edged
00 edgewise
28 effect
03 effective
00 effectiveness
04 efficiency
00 efficient
00 effluxes
00 effusion
00 eigenfunctions
01 eigenvalue
00 eighth
00 ejector
05 elastic
00 elastically
03 elasticity
01 electric
03 electrical
02 electrically
00 electrogasdynamic
01 electromagnetic
01 electromagnetically
00 electron
00 electronic
00 electroplating
00 electrostatic
02 element
01 elementary
01 elevated
00 elevator
01 elevon
01 elimination
00 ellipse
00 ellipsoid
00 ellipsoidal
14 elliptic
02 elliptical
00 ellipticity
00 elongated
00 embedded
00 embryonic
02 emissivity

00 emission

01 emitted

00 empirical

00 enclosed

00 encounter

01 end

00 ended

00 endgrain

00 endplate

00 endurance

06 energy

00 engessor

05 engine

00 eniac

00 enskog

02 entering

09 enthalpy

00 entirely

00 entrainment

01 entrance

04 entropy

05 entry

00 envelope

00 environment

01 environmental

00 epoxy

00 equal

00 equality

00 equally

35 equation

01 equatorial

00 equicohesive

00 equilateral

00 equilibration

14 equilibrium

01 equipment

01 equivalence

02 equivalent

00 erdmann

01 erosion

00 erratic

01 error

02 escape

01 estimate

04 estimation

02 ethylene

00 euler

00 evacuators

01 evaluation

01 evaporating

01 evaporation

00 event

01 exact

02 excess

00 exchange

00 exchanger

03 excitation
01 excited
00 exciting
00 excrescence
00 exerted
08 exhaust
11 exhausting
08 exit
01 exiting
01 exothermic
00 expanded
00 expanding
15 expansion
00 expenditure
10 experiment
18 experimental
00 exploded
03 explorer
00 explosion
00 explosives
01 exponent
01 exponential
02 exposed
00 expressible
01 expression
00 extended
00 extendible
00 extending
00 extensible
02 extension
00 extensional
00 extensive
00 extensometers
01 extent
05 external
01 externally
00 extinction
01 extrapolated
01 extreme
00 extruded
00 f
04 face
02 faced
00 facility
00 facing
04 factor
01 fahrenheit
00 failing
00 failsafe
01 failure
01 fair
00 fairchild
00 fairing
00 falkner
01 fall
00 falling

00 fan
01 far
00 farnborough
01 fast
00 fatique
00 favourable
01 feedback
00 feeding
00 fenter
00 ferri
00 ferrous
00 fiberglass
00 fibre
00 fibrous
15 field
00 fifth
00 fighter
02 filament
00 filled
00 filler
01 filling
00 film
01 filter
00 filtered
00 fin
01 final
00 finding
00 fineness

18 finite
00 finned
00 fire
01 firing
02 first
01 fission
00 fit
00 fitting
00 five
01 fivestage
02 fixed
00 fixing
02 flame
00 flange
00 flanged
05 flap
01 flapping
01 flare
00 flared
33 flat
00 flattening
03 flexibility
02 flexible
00 flexibly
01 flexural
01 flexure
13 flight
00 floating

143	flow
00	flowing
01	flowmeter
00	fluctuating
02	fluctuation
00	flugge
18	fluid
00	fluidized
00	fluorochemicals
11	flutter
01	fluttering
03	flux
00	flying
00	flywheel
00	foam
00	foamed
00	focal
00	fog
00	foil
02	folding
00	following
00	foot
32	force
02	forced
00	forcible
01	forcing
04	forebody
00	foredrag
00	foreign
00	forepart
00	foreplane
07	form
03	formation
00	formed
00	formica
04	formula
00	formulation
08	forward
00	foundation
00	four
02	fourier
00	fourth
04	fraction
00	fracture
00	frame
00	framed
00	framework
00	france
19	free
00	freefree
03	freedom
01	freentering
01	freestream
00	freely
00	freeman
00	freeze

02 freezing
01 freon
09 frequency
00 fresnal
13 friction
03 frictional
01 frictionless
00 fringe
02 front
04 frozen
00 fruitfly
00 frustum
02 fuel
00 fuelling
00 full
00 fuller
00 fully
19 function
00 fundamental
01 fused
04 fuselage
00 fusiform
01 fusion
00 g
00 gain
00 galcit
00 galerkin
00 gamma
00 gap
22 gas
00 gasdynamic
00 gaseous
01 gauge
00 gauss
00 gaussian
01 gear
00 geared
01 general
05 generalized
02 generated
00 generating
00 generation
03 generators
00 geodsic
00 geometric
00 geometrical
00 geometrically
03 geometry
00 gerard
01 given
00 glancing
01 glass
00 glassy
00 glauert
02 glide
05 glider

00 glycerin
00 good
00 goodman
00 gortler
00 gothic
00 governed
00 graded
12 gradient
00 gradual
00 graham
01 grain
01 graphical
03 graphite
00 grasshof
01 grate
00 gravel
00 gravelos
01 gravitational
06 gravity
00 graze
01 gree n
00 gregg
00 grid
00 groove
02 gross
02 ground
00 group

05 growth
00 guidance
02 guide
00 guided
01 gun
06 gust
00 gyration
00 gyroscope
01 gyroscopic
00 h
00 haack
06 half
00 hall
00 hamel
00 hammerhead
00 handleypage
01 handling
00 hard
00 hardening
00 harmonic
02 harmonically
01 hartmann
00 hartree
00 haveg
00 hazard
00 he
04 head

00 headed
00 heaps
37 heat
02 heated
00 heater
13 heating
00 heave
00 heaving
01 heavy
08 height
00 heisenberg
00 helical
00 helicopter
00 heliocentric
04 helium
00 helix
01 helmholz
03 hemisphere
00 hemispheric
03 hemispherical
01 hemispherically
00 heterogeneous
01 hexachlorethane
00 hexagonal
00 hiemenz
26 high
00 higher
02 highly

00 hiller
00 hinge
01 hinged
00 historical
03 history
00 hodograph
00 hoff
00 hogging
00 hohmann
01 holding
01 hole
00 hollow
00 homas
00 homing
02 homogeneous
00 homologous
00 homonuclear
00 honeycomb
00 hookean
00 hoop
00 hooped
01 horizontal
00 horn
04 horseshoe
05 hot
00 housefly
00 hover

00	hovercraft
00	hovering
00	howarth
04	hub
01	hugoniot
00	human
01	humidity
00	hurwitz
00	hydroballistic
01	hydrocarbon
02	hydrodynamic
03	hydrogen
00	hydromagnetic
00	hydrostatic
00	hyperbola
00	hyperbolic
00	hypergeometric
00	hyperliptic
34	hypersonic
02	hypervelocity
00	hypothesis
00	hypothetical
00	hysol
02	hysteresis
00	hysteretic
00	i
00	ibm
00	icbm
00	ice
00	iconel
05	ideal
00	idealization
01	idealized
01	ignited
00	ignition
00	ignorable
00	illingworth
00	ilushin
00	image
00	immediately
00	immobile
00	immovable
03	impact
00	impedence
00	impeded
06	impeller
00	imperfect
00	imperfection
00	impermeable
00	impingement
00	impinging
00	imposed
01	improved
00	improvement
03	impulse
00	impulsive

00 impulsively
01 in
01 inboard
00 inch
14 incidence
01 incident
02 incipient
02 inclination
01 inclined
00 inclusion
00 incoming
16 incompressible
02 inconel
00 increase
01 increased
01 increasing
01 increment
03 incremental
00 independence
00 independent
00 index
01 indicator
08 indical
01 indirect
01 individual
18 induced
00 inductance
00 induction
00 inelastic
00 inequality
00 inert
01 inertia
01 inexorable
06 infinite
01 infinitely
00 infinitesimal
01 infinitesimally
00 infinity
00 inflected
00 inflection
00 inflow
03 influence
00 inhibition
00 inhomogeneous
04 initial
00 initialled
01 initially
01 initiated
00 initiation
00 injectant
01 injected
01 injection
00 injector
00 ink
08 inlet
02 inner

00 inorganic
00 input
00 inscribed
00 insect
01 instability
00 instantaneous
01 instrumentation
00 instruments
01 insulated
00 insulating
00 insulation
01 intake
00 integrable
08 integral
00 integrated
01 integrating
04 integration
00 integrative
00 intense
00 intensity
18 interaction
00 interangular
00 interblade
00 intercrystalline
02 interface
22 interference
00 interferential
00 interferogram
00 interferometer
00 interferometer
00 interferometric
00 interferometry
01 interior
01 interjectory
03 intermediate
00 intermittent
00 intermolecular
02 internal
01 internally
01 interplanetary
00 interpolating
00 interpolative
02 intersecting
00 intersection
00 interstage
00 interval
00 into
00 intramolecular
00 introduced
00 invariant
00 inverse
02 inversion
00 inverted
05 investigation

06 inviscid
00 inward
01 iodide
00 iodine
01 ion
03 ionization
03 ionized
00 ionosphere
00 irbm
00 iron
00 irregularity
00 irreversible
01 irrotational
05 isentropic
01 isobar
01 isobaric
00 isochrome
00 isochronous
01 isoenergetic
00 isoerg
00 isogon
00 isolated
00 isolation
00 isopycnal
00 isosceles
00 isothermal
01 isotope
01 isotropic
00 isovel
01 issuing
00 iteration
03 iterative
00 jacking
00 jacks
00 janzen
00 jeffrey
01 jeffreyhamel
27 jet
00 jogs
01 johannesen
00 joining
00 joint
00 jones
00 jouguet
01 joukowski
00 joule
00 journal
01 jumo
00 jump
00 junction
00 jupiter
00 kaminisky
01 karman
00 kelley
02 kelvin
00 kendrick

02 kernel
02 kilometre
00 kinetheodolite
02 kinetic
01 kink
00 kinking
02 kirchhoff
00 kirk
02 knee
00 knuckle
00 knudsen
00 krypton
00 kuo
01 kussner
00 krutta
00 l
01 l-method
00 laboratory
00 lacquer
00 lag
00 lagging
00 lagrange
00 lagrangian
00 lamda
22 laminar
01 laminarization
00 laminate
00 lamination
00 landahl
00 landing
00 langhaar
00 langley
00 lap
00 laplace
03 large
00 laszlo
03 lateral
01 laterally
03 latitude
00 lattice
00 launch
00 launched
00 laval
01 law
61 layer
00 layered
00 layout
01 lead
23 leading
00 least
00 leaving
00 lees
03 leeward
00 leg
00 legendre
00 leggett

10	length
00	lengthwise
00	lenticular
01	less
00	lessthan
00	level
00	lewis
00	lexan
01	libration
02	liebmann
01	life
02	lifetime
45	lift
09	lifting
03	light
00	lighthill
00	lighting
00	lightly
00	lightweight
03	limit
00	limitation
00	limited
00	limiting
08	line
07	linear
01	linearization
06	linearized
00	linearly
01	liners
00	lip
01	liquefaction
02	liquid
00	literature
12	load
01	loaded
12	loading
00	lobe
00	lobed
11	local
01	locally
00	located
19	location
00	lockfoam
01	lockheed
03	logarithmic
05	long
11	longitudinal
00	longitudinally
00	loop
00	loose
01	lorenz
00	losing
03	loss
00	love
13	low
00	lower

00 lowest
00 lubricant
00 lubrication
00 lucite
01 luminosity
01 luminous
00 lumped
00 lunar
01 lunisolar
02 lyapunov
00 maccoll
65 mach
00 machine
00 macroscopic
00 mager
01 magnesium
01 magnetic
00 magnetoaerodynamic
01 magnetofluidmechanics
00 magnetogasdynamic
01 magnetoplasma
00 magnetostriction
01 magnification
01 magnitude
00 magnus
00 maikapar
05 main
00 maintenance
01 major
00 maldistribution
00 mangler
00 manned
02 manoeuvre
00 manoeuvring
01 manometer
00 map
00 mapping
02 margin
00 maritime
00 mars
01 martian
10 mass
00 massbalanced
02 matching
10 material
00 mathematical
00 mathieu
00 matric
01 matrix
00 maxima
10 maximum
00 maxwell
00 maxwellian
00 mayer

02	mean
00	measured
27	measurement
00	measuring
00	mechanical
02	mechanics
01	mechanism
00	media
00	median
01	medium
00	melamine
00	melting
00	member
00	membrane
00	mercury
02	merged
00	merger
00	merging
00	meridian
02	meridional
01	mesh
00	metal
00	meteor
01	meteorite
01	meteoroid
00	meter
01	methane
00	methanol
21	method
02	meyer
00	microphone
00	microwave
00	mid
01	midas
00	midchord
01	midcourse
01	middle
00	midplane
00	midpoint
00	midspan
01	mild
01	miles
00	millikan
00	milliseconds
00	minimisation
00	minimizing
01	minimum
01	minor
00	mirels
00	misaligned
00	misalignment
00	mises
00	miss
03	missile
01	mission
00	mit
08	mixed

08 mixing

04 mixture

02 modal

09 mode

28 model

01 moderate

00 modification

05 modified

00 modifying

00 modulated

00 modulating

00 modulation

01 modulus

01 moisture

01 mol

05 molecular

02 molecule

01 molybdenum

24 moment

00 momentary

06 momentum

00 monatomic

00 monocell

00 monocoque

00 monolithic

00 monoplane

00 monotonic

00 monoxide

00 morley

19 motion

00 motionless

00 motor

00 mound

01 mounted

00 mounting

00 movable

02 movement

03 moving

00 muffler

00 multi

00 multiaxial

00 multibay

00 multiblade

00 multicell

00 multicomponent

00 multilayered

00 multiphase

04 multiple

00 multiplication

00 multiplier

00 multiply

00 multipropeller

00 multirib

00 multisectional

00 multispar

02 multistage

00 multiweb
00 mutual
00 m[illegible]-1
00 mylar
00 n
03 naca
04 nacelle
02 narrow
00 nash
02 natural
00 nature
01 nautical
02 navier
03 navierstokes
00 navigation
02 near
00 nearest
03 nearly
00 neartriangle
01 neartriangular
00 neck
00 negative
00 negatively
00 negligible
02 net
00 network
00 neumann
01 neutral
00 newmexico
00 newton
05 newtonian
00 ngte
00 nicholson
00 nickel
00 night
01 nighttime
00 nimonic
00 niordson
00 nitric
04 nitrogen
00 nitrous
00 no
00 nocturnal
00 nodal
03 node
04 noise
01 nolift
00 nominal
01 nonablating
00 nonaligned
00 nonaxisymmetric
00 nonaxisymmetrical
01 noncatalytic
00 noncircular
00 noncirculatory
00 nonconcurrence

00 nonconducting
00 nonconductive
00 nondimensional
00 nondirect
01 nondissipating
01 nondissipative
00 nonelastic
05 nonequilibrium
00 nonflammable
00 nonhomogeneous
00 noninclined
00 nonisothermal
04 nonlifting
05 nonlinear
00 nonlinearity
00 nonmonotonic
00 nonnegative
00 nonoscillatory
01 nonparallel
01 nonperfect
00 nonplanar
00 nonporous
00 nonradiating
00 nonreacting
00 nonreactive
00 nonrecoverable
00 nonrelativistic
00 nonrotating
00 nonrotational
00 nonseparating
00 nonsimilar
00 nonslender
00 nonsolid
02 nonstationary
02 nonsteady
00 nonsymmetric
00 nontoxic
00 nontruncated
00 nonturbulent
00 nonuniform
00 nonuniformity
00 nonuniformly
00 nonvanishing
05 nonviscous
00 nonweiler
00 nonyawing
00 nonzero
20 normal
00 normally
14 nose
08 nosed
01 nosepiece
00 not
01 notsoslender
00 notch
23 nozzle

01 npl
01 nuclear
35 number
15 numerical
00 nusselt
00 nylon
00 object
03 oblate
01 oblateness
02 oblique
00 obliterated
02 observation
00 obstacle
00 obtained
00 occurrences
00 octahedral
01 octogonal
00 off
00 ogee
00 ogival
02 ogive
04 oil
01 oilflow
00 oliver
00 omega
00 omission
02 one
01 onedimension
05 onedimensional
00 onera
06 onset
00 onto
02 open
00 opening
00 operating
03 operation
00 operational
00 operator
00 opposed
00 opposite
00 optical
00 optimal
01 optimization
01 optimum
10 orbit
04 orbital
00 orbiting
02 order
00 ordered
00 ordinary
01 ordinate
01 orientation
01 orifice
00 originally
01 originating
00 orr

01 orthogonal
00 orthogonality
00 orthogonally
00 orthotropic
10 oscillating
10 oscillation
00 oscillator
09 oscillatory
01 oscillograph
00 oscillography
00 oscilloscope
00 oseen
00 osgood
03 outboard
02 outer
00 outermost
01 outflow
03 outlet
00 outofroundness
00 outofstraightness
00 output
00 outside
00 outward
00 oval
00 over
01 overall
01 overexpanded
00 overexpansion
00 overhang
00 overpressure
01 overrelaxation
00 overshoot
00 overstability
00 overswing
00 oxidation
00 oxide
00 oxidizer
05 oxygen
00 pace
00 packard
00 painleve
00 paint
01 pair
00 pane
04 panel
00 panting
00 paper
00 papreg
00 parabola
06 parabolic
00 paraboloid
00 paraboloidal
07 parallel
06 parameter

00 paraplex
00 parasitic
00 parasol
03 part
03 partial
00 partially
04 particle
00 particular
01 partition
00 partly
00 pass
00 passage
01 passing
00 passive
01 past
05 path
10 pattern
01 pay
00 payload
01 peak
00 peaktopeak
01 peaky
01 peclet
01 penalty
01 pendulum
02 penetrating
04 penetration
04 percent
02 percentage
02 perfect
00 perfectly
01 perforated
00 perforation
10 performance
08 perigree
00 perimeter
06 period
02 periodic
00 periodically
00 periodicity
00 peripheral
00 permanent
00 permeable
00 permissible
01 perpendicular
02 perpendicularly
00 perspex
05 perturbation
00 perturbed
04 phase
00 phenolic
03 phenomena
00 phenomenological
00 philosophy
00 phosphorescent
00 photoelastic

00 photoelectric

05 photograph

02 photographic

00 photography

01 photomultiplier

01 photorecording

00 photothermoelastic

00 photothermoelasticity

00 physical

01 phugoid

00 pibal

01 pickup

00 picture

00 piece

00 piezometer

00 pigment

00 piled

00 pilot

01 piloting

00 pimple

00 pin

01 pine

00 pinned

01 pipe

03 piston

07 pitch

21 pitching

01 pitchup

00 pitometer

00 pitot

02 pivot

02 pivotal

00 plain

00 planar

00 planck

08 plane

01 planet

06 planetary

00 planetocentric

08 planform

00 plant

00 plaskon

00 plasma

01 plastic

00 plasticity

27 plate

00 plateau

02 plates

00 plating

00 plenum

00 plexiglass

00 plk

00 plot

03 plotting

00 plug

00 plume

01	plunging
00	plywood
00	pneumatic
00	pocket
00	poggi
00	pohle
02	pohlhausen
00	poincare
27	point
01	pointed
01	poiseuille
00	poisson
01	polar
00	pole
00	polished
00	polyatomic
00	polyaxial
00	polycrystalline
00	polyester
01	polygon
00	polygonal
01	polymer
00	polynomial
00	polystyrene
00	pondermotive
00	porous
01	portion
09	position
00	positioning
01	positive
01	possion
00	post
01	postbuckling
00	potassium
13	potential
00	potentiometer
01	pound
01	powell
04	power
00	powered
00	powerplant
01	practical
05	prandtl
00	preasymptotic
00	prebuckled
00	prebuckling
00	precession
0o	precipitation
15	prediction
00	preferential
00	preliminary
00	preloading
00	premixed
00	prerotation
02	prescribed
00	presence

98	pressure
00	pressurization
00	pressurized
00	preston
00	prevented
00	prevention
02	prewhirl
02	primary
01	principle
00	prior
00	prismatic
00	probability
04	probe
08	problem
00	probstein
01	procedure
02	process
00	processed
01	product
01	production
19	profile
00	programme
00	programmed
00	programming
02	progressive
00	projected
00	projectile
01	projection
01	prolate
00	promoter
01	promotion
00	proof
01	propagating
01	propagation
02	propellants
01	propelled
02	propeller
07	property
00	proportion
00	proportional
02	propulsion
04	propulsive
01	protection
00	proton
00	protuberance
00	proturbulence
00	providing
01	proximity
00	pspp
00	pseudo
00	pulse
02	pump
01	pure
00	pyramidal
00	quadrature
00	quadrupole

00 qualitative
01 quality
00 quantitative
00 quantity
00 quarter
00 quartic
01 quartz
02 quasi
00 quasicircular
02 quasiconical
00 quasicylinder
00 quasicylindrical
00 quasiequilibrium
00 quasionedimensional
00 quasisteady
00 quasiunsteady
00 quenching
00 quick
00 rabotnov
00 radar
04 radial
00 radially
00 radiant
00 radiating
08 radiation
02 radiative
01 radiator
01 radioactive
00 radiotrajectograph
03 radius
03 rae
00 rakes
00 ramberg
01 ramp
02 random
09 range
01 rankine
00 raphson
00 rapid
00 rarefaction
02 rarefied
22 rate
61 ratio
01 raw
00 ray
00 raybestos
03 rayleigh
02 reacting
10 reaction
00 reactive
00 reactor
00 reading
04 real
05 rear
01 rearward
00 reattached

00 reattaching
03 reattachment
00 receiver
02 reciprocal
00 reciprocity
00 recirculating
03 recombination
00 recompression
01 record
00 recording
00 recoverable
03 recovery
00 rectangle
10 rectangular
00 rectilinear
00 redirecting
00 redistribution
01 reduced
01 reducted
10 reduction
00 redundant
00 reentering
01 reentrant
15 reentry
00 reestablishment
01 reference
00 refinement
03 reflected

00 reflecting
06 reflection
00 refraction
00 refractory
00 refrasil
03 regime
09 region
01 regression
00 regular
00 regulation
00 reimpingement
00 reinforced
00 reissner
09 relation
01 relationship
05 relative
00 relatively
00 relativistic
07 relaxation
00 relaxational
00 relaxing
01 relay
01 release
01 reliability
00 remain
02 removal
01 removed
00 reorbit

00 replacement
00 replenishment
00 representation
00 required
03 requirement
01 research
01 reservoir
00 residual
00 residue
00 resin
01 resistance
00 resisted
00 resisting
00 resolidification
00 resolution
02 resonance
01 resonant
04 response
01 rest
01 restart
00 resting
00 restoring
00 restrained
00 restraining
00 restraint
00 restricted
07 result
01 resultant
00 resulting
00 retardation
00 retarded
01 retarding
02 retrorocket
00 return
00 reuse
03 reversal
00 reverse
01 reversed
01 reversibility
00 review
00 revised
13 revolution
00 rex
27 reynolds
00 rf
00 rheological
00 rhombic
00 rib
00 ribbon
00 riccatti
02 richardson
00 ridge
01 riemann
00 right
06 rigid
01 rigidity
01 rigidly
00 rim

00 ring

00 ripple

09 rise

00 ritz

00 rivet

00 rms

14 rocket

00 rocketon

01 rod

02 roll

00 rolled

04 rolling

00 roof

01 rooftop

01 room

03 root

02 rotary

07 rotating

04 rotation

06 rotational

00 rotatory

03 rotor

00 rough

03 roughness

00 round

01 rounded

00 rounding

01 roundingoff

00 roundness

01 routine

00 routt

01 routthurwitz

02 row

00 rubber

01 rudder

01 rule

01 running

00 rupture

00 sae

01 safety

01 sail

01 salt

00 sample

00 sampling

00 sand

01 sandpaper

00 sandwich

13 satellite

01 saturation

00 saturn

00 saundersroe

00 saving

07 scale

01 scaling

00 scattering

01 scavenging

00 schindel
01 schlichting
04 schlieren
00 schmidt
00 schubauer
00 scoop
00 scooped
00 scooping
00 screen
00 screw
00 sea
00 seal
00 sealing
00 sears
02 season
01 seasonal
00 secant
02 second
01 secondary
02 secondorder
23 section
02 sectional
00 sector
00 sectorial
00 sedov
01 seeded
04 segment
00 segmentation
00 segmented
00 seide
01 selected
01 self
01 selfinduced
00 semi
00 semianalytical
00 semiapex
00 semiballistic
00 semicircular
01 semiellipsoid
00 semiellipsoidal
00 semiempirical
03 semiinfinite
00 semiinverse
03 semimajor
00 seminumerical
00 semirarefied
00 semirigid
00 semispan
01 semivertex
00 sensitivity
01 sensor
04 separated
00 separating
27 separation
00 sequential
03 series
01 servo
00 set

01	setting	00	shift
00	settling	00	ship
00	seventh	44	shock
01	severe	00	shocking
01	severely	00	shockless
00	sextic	01	short
02	shadowgraph	00	shortening
00	shaft	04	shroud
00	shakedown	00	shrouded
00	shallow	00	shuffle
00	shallowness	00	sicromo?
00	shank	02	side
00	shanley	00	sided
25	shape	00	sidedness
01	shaped	00	sideforce
14	sharp	04	sideslip
00	sharpness	00	sidewall
06	shear	01	sidewash
00	sheared	00	signals
00	shearing	00	silencer
00	sheath	01	silica
00	shedding	00	silicate
02	sheet	00	similar
00	shell	01	similarity
00	shesterikov	01	similitude
02	shield	01	simple
00	shielded	00	simplification
01	shielding	00	simplified

01	simply
[illegible]	simulated
00	simulating
02	simulation
00	simulator
00	simultaneous
00	simultaneously
00	sine
05	single
01	singly
00	singular
00	singularity
00	sink
[illegible]	sinking
[illegible]	sinusoidal
00	sinusoidally
00	siren
00	situation
01	six
00	sixth
08	size
00	skan
01	skewed
18	skin
01	skip
00	skipping
00	skirt
00	skirted
02	slab
00	slabtail
00	slat
08	slender
00	slenderness
00	slices
00	slider
01	slightly
05	slip
00	sliplines
01	slipstream
10	slope
00	sloped
00	sloshing
03	slot
03	slotted
00	slow
02	slowly
01	slug
13	small
00	smoke
00	smooth
00	smoothing
00	smoothness
00	snap
00	snapping
00	snow
00	soaked

00	soaking
00	sod
02	sodium
01	soft
04	solar
10	solid
43	solution
00	sommerfield
17	sonic
00	soret
03	sound
01	sounding
03	source
00	southwell
05	space
00	spacecraft
00	spaced
00	spaceship
02	spacing
10	span
01	spanning
12	spanwise
00	spar
00	spark
00	sparrow
00	spatial
01	species
08	specific
01	specimen
02	spectra
00	spectral
00	spectrography
01	spectrum
00	specular
28	speed
03	sphere
07	spherical
02	spherically
01	spheroid
01	spike
01	spiked
01	spin
00	spinner
00	spinning
00	spiral
00	spiralling
00	split
01	splitter
01	spoiler
00	spot
00	spray
00	spread
00	spreading
00	spring
00	spruce
03	sputnik
01	square
00	squires

00 srn
18 stability
00 stabilization
00 stabilized
00 stabilizer
00 stabilizing
02 stable
02 stacking
04 stage
01 stagger
01 staggered
00 staggering
00 stagnant
32 stagnation
00 stainless
06 stall
02 stalled
03 stalling
00 stalmach
00 stand
01 standard
00 standing
06 standoff
00 stanton
00 start
02 starting
04 state
21 static
01 statically
00 station
03 stationary
01 statistical
00 statistics
01 stator
17 steady
00 steam
01 steel
00 steep
00 steepest
00 stefan
00 stem
01 step
00 stepbystep
00 stepdown
00 stepwise
00 stewartson
00 stiffened
01 stiffener
00 stiffening
08 stiffness
01 still
01 sting
00 stochastic
01 stoichiometric
03 stokes
00 stol

00	stone
00	stopping
00	storage
01	store
01	stores
00	storings
03	straight
00	straightness
00	strain
00	straintime
01	stratford
00	stratiform
28	stream
09	streamline
01	streamtube
03	streamwise
01	street
05	strength
07	stress
00	stressed
00	stressing
00	stretched
00	stretching
00	striking
01	stringer
00	strioscopy
03	strip
00	struboscopic
03	strong
00	strouhal
03	structural
05	structure
00	strut
05	study
00	stvenant
00	subarc
00	subaudio
00	subcritical
00	subject
01	subjected
00	sublayer
03	sublimination
00	submerged
31	subsonic
01	substantial
00	substitutes
03	successive
00	sucking
04	suction
01	sudden
00	sugar
01	sun
00	superaerodynamic
00	supercircular

00 supercritical

00 superfast

00 superimposed

02 superposition

01 supersatellite

57 supersonic

00 supersonically

00 supply

00 supplying

02 support

01 supported

01 supporting

00 suppression

55 surface

00 surfaced

04 surge

00 surrounding

05 survey

00 suspension

00 sustained

00 sustaining

00 sutherland

00 swallowing

00 sweat

07 sweep

03 sweepback

00 sweepforward

19 swept

13 sweptback

00 sweptforward

00 swirl

00 switching

02 symmetric

07 symmetrical

00 symmetrically

00 symmetry

00 synthesis

08 system

01 systematic

00 t

02 tab

04 table

01 tabulation

04 tail

01 tailboom

01 tailless

00 tailored

00 tailoring

01 tailplane

00 takeoff

00 tangency

01 tangent

03 tangential

00 tank

01 tap

03 taper

02 tapered
00 tapped
01 tapping
01 target
00 taxiing
01 taylor
02 technique
00 teeth
03 teflon
00 telegraph
01 telemetering
00 telemetry
00 television
00 teller
40 temperature
00 tending
00 tensile
02 tension
00 tensor
00 term
02 terminal
00 terminated
00 termwise
49 test
05 testing
00 tetrachloride
01 theodorsen
01 theorem
15 theoretical
42 theory
07 thermal
01 thermally
00 thermoaeroelastic
00 thermochemical
00 thermocouple
03 thermodynamic
00 thermoelastic
00 thermold
00 thermomechanical
00 theta
06 thick
01 thickened
02 thickening
23 thickness
09 thin
00 third
00 thorable
01 three
12 threedimensional
00 threedimensionality
03 threepoint
00 threshold
04 throat
00 throttle
02 through
12 thrust

01	thwaites
00	tilt
00	tilting
12	time
01	timeoptimum
00	timewise
00	timken
00	timkenrollerbearingco.
10	tip
00	titan
00	titanium
00	tnt
00	tolerance
01	tollmien
01	tollmienschlicht
00	tollmienschlichting
00	top
00	torda
00	toriconical
00	torispherical
00	toroidal
01	torque
00	torsion
03	torsional
01	torso
00	torus
18	total
00	towards
00	traces
00	tracing
00	tractions
00	trail
11	trailing
05	trajectory
00	transcendant
00	transcendental
00	transducers
23	transfer
00	transferred
00	transform
03	transformation
00	transformed
09	transient
00	transit
13	transition
04	transitional
02	translation
00	translational
00	translatory
00	transmission
22	transonic
00	transparent
01	transpiration
03	transport
00	transtability
00	transversality

01	transverse
00	transversely
00	trapezoidal
01	travelling
00	traversal
01	traverse
00	traversing
00	treatment
00	trefftz
01	triangle
04	triangular
00	trigonometric
02	trim
00	trimmed
00	trimming
00	trip
00	tripped
00	tripping
00	true
01	truncated
00	truss
00	tsien
11	tube
00	tubing
00	tubular
00	tuft
02	tumbling
01	tungsten
62	tunnel
00	turbine
04	turbojet
01	turbomachine
01	turbulence
16	turbulent
00	turn
01	turning
00	twin
03	twist
02	twisted
00	twisting
04	two
35	twodimensional
01	twodimensions
06	type
00	uk
00	ultimate
00	ultrahigh
01	ultraviolet
00	unaxial
00	unbanked
00	unblunted
01	unbounded
00	unbuckled
01	uncambered
00	unchanged
00	uncooled
01	uncoupled

00	under
00	underexpanded
00	underexpansion
00	undergoing
00	undershoot
00	undersurface
01	underwater
01	undissociated
00	undisturbed
00	unelastic
00	unequal
00	unevenness
00	unfired
00	unflanged
01	unfolding
01	unheated
00	uniaxial
01	unidirectional
00	unified
07	uniform
00	uniformity
00	uniformly
00	unimodal
01	unit
01	unity
00	univac
00	unloaded
00	unloading
00	unperturbed
00	unpowered
00	unpressurized
00	unretarded
00	unseparated
01	unstalled
01	unstalling
00	unsteadily
00	unsteadiness
09	unsteady
00	unstiffened
00	unsupported
02	unswept
00	unsymmetrical
01	untapered
01	unwind
00	unwrinkled
00	unyawed
00	upflow
00	upload
13	upper
01	uprating
07	upstream
02	upwash
00	ur
00	use
00	v
01	vacuum

00 valid
03 value
01 valued
00 valve
00 vandriest
00 vandyke
04 vane
01 vaneless
01 vanguard
03 vanishing
00 vanishingly
01 vapour
01 vapourization
06 variable
17 variation
01 variational
00 varying
04 vector
19 vehicle
44 velocity
00 venting
01 venturis
00 venus
00 verification
00 vertex
08 vertical.
00 vertol
01 very
00 vessels
00 vibrating
06 vibration
01 vibrational
01 vibrationally
00 vibratory
00 vicinity
00 virtual
02 viscid
00 viscoelastic
00 viscoelasticity
00 viscoplastic
05 viscosity
23 viscous
00 visibility
00 vision
00 visual
00 visualization
00 volterra
01 volume
00 volumetric
01 vonkarman
16 vortex
00 vortical
12 vorticity
00 voyage
00 vtol
00 w

01 wagner
00 waists
09 wake
00 wakelike
00 walkden
25 wall
00 walled
00 walles
01 ward
00 warhead
00 warp
00 warpage
00 warped
01 warren 12
00 washed
01 water
00 waterproofing
40 wave
00 waveform
01 wavelength
00 waviness
00 wavy
00 weak
01 weakening
00 weapon
00 web
10 wedge
00 weierstrauss
10 weight
00 weighting
00 weinstein
01 weissinger
00 wetted
00 wetting
01 whirl
00 whitham
00 whole
02 wide
00 widely
04 width
55 wind
00 window
02 windward
59 wing
02 winged
00 wingless
03 wire
00 with
01 within
00 without
01 wood
00 work
05 working
00 woven
00 wrinkled
00 wrinkling

00 x

00 xenon

03 yaw

02 yawed

01 yawing

00 yield

00 young

00 yoyo

00 z

10 zero

00 zinc

02 zone

00 zoom

APPENDIX B

DOCUMENT INDEXING

1302	07	AIR	N	T	V		S
1302	06	ALTITUDE	N		V	M	
1302	08	APPROXIMATION	N	T	V		
1302	08	ATMOSPHERE	N		V	M	S
1302	05	BOUNDARY			V	M	S
1302	06	CLOSED					
1302	08	COEFFICIENT	N		V	M	S
1302	06	COLLISION			V	M	S
1302	07	COMPLETE			V		
1302	06	COMPONENT	N		V	M	S
1302	08	COMPRESSIBILITY	N		V		S
1302	08	CONDUCTIVITY	N		V	M	
1302	06	DEGREE			V		S
1302		DETERMINATION	N		V		S
1302	07	EFFECT	N		V		
1302	07	ENERGY			V	M	S
1302	08	ENTHALPY	N		V		S
1302	08	ENTROPY	N		V	M	S
1302	07	EQUILIBRIUM	N		V	M	S
1302	10	FAIR			V	M	S
1302	05	FLUX	N		V	M	S
1302	06	FORM	N				S
1302	07	FRACTION	N		V	M	S
1302	07	FULLY			V		S
1302	05	FUNCTION	N		V		S
1302	06	GAS			V		S
1302	08	HEAT	N		V		S
1302	10	HIGH		T	V		S
1302	07	IONIZED			V		S
1302	08	KELVIN	N		V	M	S
1302	06	KINETIC			V	M	S
1302	05	LAYER	N		V	M	S
1302	07	MOL			V		S
1302	07	NONEQUILIBRIUM			V		S
1302	08	NUMBER	N		V		S
1302	06	PARTICLE	N		V		SA
1302	05	PARTITION			V		S
1302	08	PRANDTL					S
1302	09	PROPERTY	N	T	V	M	S
1302	08	SOUND	N		V		S
1302	08	SPECIFIC			V		S
1302	08	SPEED	N		V		S
1302	10	TEMPERATURE	N	T	V	M	S
1302	06	THEORY	N		V	M	S
1302	08	THERMAL			V		S
1302	09	THERMODYNAMIC		T	V	M	S
1302	09	TRANSPORT		T	V		
1302	08	VISCOSITY	N		V		S
1311	07	BLUNT			V	M	S
1311	10	BOUNDARY	N			M	S
1311	10	BUFFET			V		S
1311	10	BUFFETING	N	T	V	M	S
1311	08	BUZZ	N		V		S
1311	07	COEFFICIENT			V		S
1311	09	DIVERGENCE	N		V		S

1311	10	EDGE	N		V	M	S
1311	05	EFFECT	N	T	V	M	
1311	06	FLIGHT	N		V		S
1311	07	FLOW	N		V		S
1311	07	FORWARD			V	M	
1311	08	INCIDENCE	N		V	M	S
1311	07	INCREASING			V	M	S
1311	09	INDUCED			V		S
1311	09	LAYER			V		S
1311	10	LEAD			V		S
1311	09	LEADING			V		S
1311	08	LIFT			V	M	S
1311	07	LOCATION	N		V		
1311	07	MACH	N		V	M	
1311	09	MODEL	N	T	V	M	S
1311	09	ONSET	N	T	V		S
1311	08	OUTBOARD	N		V	M	S
1311	07	POSITION			V	M	S
1311	09	PREDICTION	N	T	V	M	S
1311	09	PRESSURE			V	M	S
1311	09	REAR				M	S
1311	09	RIGID		T	V	M	
1311	06	SCALE			V		S
1311	09	SEPARATION	N	T	V	M	S
1311	09	SHOCK			V		S
1311	08	SPANWISE			V		S
1311	07	SPEED			V	M	S
1311	07	SUPERSONIC			V		S
1311	08	SWEPTBACK			V	M	S
1311	06	TAPPING	N		V	M	
1311	07	TEST	N	T	V	M	S
1311	10	TRAILING			V		
1311	09	TUNNEL	N	T	V	M	S
1311	10	UNSTEADY				M	S
1311	09	VARIATION			V		S
1311	08	VORTEX					
1311	08	WAKE				M	
1311	08	WAVE				M	
1311	07	WIDTH			V		S
1311	09	WIND		T		M	S
1311	09	WING	N		V	M	S
1316	07	AEROFOIL	N		V	M	
1316	09	BOUNDARY	N	T	V		S
1316	05	CHORDWISE			V	M	S
1316	05	COEFFICIENT			V	M	S
1316	06	DISPLACEMENT	N		V		S
1316	05	DISTRIBUTION	N		V		S
1316	08	DIVERGENT			V		S
1316		FLOW	N		V	M	S
1316	09	HIGH		T	V	M	S
1316	09	INCIDENCE	N	T	V	M	S
1316	09	LAYER		T	V		S
1316		LIFT	N		V		S
1316	07	MACH	N		V		S
1316	09	ONSET	N		V	M	S
1316	06	OUTFLOW	N		V		

1316	06	POSITION	N		V	M	S	
1316	07	PRESSURE	N		V	M	S	
1316	06	REATTACHMENT	N		V	M	S	
1316	06	RECOVERY	N		V	M	S	
1316	08	SECTION			V		S	
1316	06	SEPARATED			V			
1316	10	SEPARATION	N	T	V		S	
1316	08	SHAPE	N		V		S	
1316	06	SHOCK			V	M		
1316	05	SPANWISE			V	M		
1316	09	SPEED	N	T	V	M	S	A
1316	05	STEADY			V		S	
1316	07	SUBSONIC			V		S	
1316	07	SUPERSONIC				M	S	
1316	06	SURFACE			V		S	
1316	08	SWEPTBACK			V		S	
1316	06	THICKNESS	N		V	M	S	
1316	07	TWODIMENSIONAL			V			A
1316	06	UPPER			V		S	
1316	06	VORTICES	N		V		S	
1316	08	WING	N		V		S	
1317	07	AMOUNT			V	M	S	
1317	07	APPROXIMATION	N		V		S	
1317	10	BLUFF			V	M		
1317	09	BODY	N		V	M	S	
1317	08	BOW			V	M	S	
1317	07	DENSITY			V	M		
1317	10	DISSOCIATING		T	V		S	
1317	08	DISSOCIATION	N		V		S	
1317	08	EXCITATION	N				S	
1317	09	FLOW	N			M	S	
1317	09	GAS	N	T	V		S	
1317	10	IDEAL			V		S	
1317	07	INFINITESIMALLY			V		S	
1317	08	MODE	N		V		S	
1317	07	NEWTONIAN			V	M	S	
1317	08	NODE	N		V		S	
1317	10	NONEQUILIBRIUM		T		M	S	
1317	09	NORMAL			V	M	S	
1317	07	PASSING			V	M	S	
1317	07	POSITION	N			M	S	
1317	07	PREDICTION	N			M	S	
1317	07	PRESSURE			V		S	
1317	07	PROFILE	N		V	M	S	
1317	08	ROTATIONAL			V	M	S	
1317	10	SHOCK			V		S	
1317	10	SPHERE	N			M	S	
1317	08	STREAMLINE			V			
1317	07	TEMPERATURE			V	M	S	
1317	09	THEORY	N	T	V		S	
1317	07	THIN					S	
1317	07	VARIATION	N		V	M	S	
1317	08	VIBRATIONAL			V		S	
1317	10	WAVE	N		V	M		

1320	09	ACCURATE			V		
1320	10	BLASIUS		T	V		S
1320	08	BLOWING	N		V		S
1320	09	BOUNDARY		T	V	M	
1320	08	COCURRENT			V		
1320	09	CONDITION	N	T	V		A
1320	07	FLAT			V	M	S
1320	07	FLOW	N		V	M	S
1320	08	JET			V		
1320	07	LAMINAR			V	M	
1320	07	LAYER			V	M	S
1320	08	MIXING	N		V		S
1320	09	NUMERICAL		T		M	S
1320	07	PLATE	N		V	M	S
1320	09	PROBLEM	N	T	V	M	S
1320	09	SOLUTION	N	T	V	M	S
1320	08	STREAM	N		V	M	S
1320	09	THREEPOINT		T	V		
1321	06	ANALYTIC			V	M	S
1321	10	BLASIUS		T	V	M	S
1321	09	BOUNDARY		T	V		
1321	06	COMPUTER	N		V	M	
1321	09	CONDITION	N	T	V	M	SA
1321	09	CONSTANT			V		S
1321	09	CONTINUATION	N		V		S
1321	09	DISTRIBUTION	N			M	S
1321	09	FLOW	N		V	M	S
1321	09	FLUID			V	M	S
1321	09	JET			V	M	S
1321	09	LAMINAR			V		S
1321	09	LAYER			V	M	S
1321	09	MIXING	N		V	M	S
1321	09	NUMERICAL		T			
1321	09	PRESSURE			V		S
1321	10	PROBLEM	N	T	V	M	S
1321	09	REST	N		V	M	S
1321	09	SEPARATED			V	M	
1321		SERIES	N		V		S
1321	09	SOLUTION	N	T	V		S
1321	09	STEADY			V	M	S
1321	06	TAYLOR			V	M	S
1321	09	THREEPOINT		T	V	M	
1321	09	TWODIMENSIONAL			V	M	
1321	09	VELOCITY			V		S
1321	09	WAKE			V		
1322	09	ASYMPTOTIC			V		
1322	10	BLASIUS		T	V		
1322	09	BOUNDARY		T	V		
1322	09	CONDITION	N	T		M	SA
1322	08	FLUID			V		S
1322	09	INTEGRATION			V	M	

1322	09	METHOD	N		V	M	
1322	08	MIXING	N		V	M	S
1322	09	PROBLEM	N	T	V	M	
1322	09	SOLUTION	N	T	V	M	S
1322	09	THREEPOINT		T	V		S
1324	07	AXISYMMETRIC			V	M	
1324	09	BOUNDARY			V		S
1324	06	CURVATURE	N		V	M	S
1324	06	CYLINDRICAL			V		S
1324	06	DISPLACEMENT	N		V	M	
1324	09	FLOW	N	T	V	M	S
1324	09	FLUID	N	T	V	M	S
1324	09	INCOMPRESSIBLE		T	V		
1324	05	INVISCID			V		S
1324	09	LAYER			V	M	S
1324	07	PLANE			V	M	
1324	09	POINT		T		M	S
1324	06	ROTATIONAL			V		S
1324	09	SHEAR	N		V	M	S
1324	05	SHOCK	N		V		S
1324	06	SLIP			V	M	S
1324	06	SPHERICAL					
1324	10	STAGNATION		T	V	M	
1324	06	THICKNESS	N		V		S
1324	07	THREEDIMENSIONAL			V	M	S
1324	07	TWODIMENSIONAL			V	M	S
1324	09	VISCOUS		T	V	M	
1324	10	VORTICITY	N	T	V	M	S
1335	10	ARC			V		S
1335	09	BOUNDARY		T			S
1335	10	CIRCULAR			V		S
1335	09	DISTRIBUTION	N		V	M	S
1335	08	EXPANSION			V		S
1335	09	FLOW	N	T		M	S
1335	10	INTERACTION	N	T	V		
1335	09	LAYER	N	T	V	M	
1335	10	PATTERN	N		V		S
1335	09	PRESSURE				M	S
1335	10	PROFILE	N				S
1335	08	REFLECTION	N				S
1335	09	SEPARATION	N		V	M	
1335	10	SHOCK		T	V		
1335	09	TEST	N		V	M	
1335	10	TRANSITION	N		V		S
1335	09	TRANSONIC		T	V	M	S
1335	09	TUNNEL			V	M	
1335	10	WAVE	N	T		M	
1335	09	WIND					S
1335	08	ZONE	N				S

1351	08	CHANNEL	N		V		S
1351		CONSTANT				M	S
1351	08	CONVERGING			V	M	S
1351	09	DISTRIBUTION	N	T	V	M	S
1351	08	DIVERGING			V		
1351	09	EXACT			V	M	S
1351	09	FLOW	N	T	V	M	S
1351	09	FLUID	N		V		
1351	08	HYDRODYNAMIC			V	M	S
1351	09	INCOMPRESSIBLE			V	M	S
1351	10	JEFFERYHAMEL		T	V		S
1351	09	LAMINAR			V	M	S
1351	10	NONPARALLEL		T	V		
1351	10	PLANE					S
1351	08	PRANDTL	N		V		
1351	08	PROBLEM	N			M	S
1351	07	PROFILE	N		V		S
1351	08	REYNOLDS	N		V	M	S
1351	09	THERMAL		T	V	M	S
1351	08	THERMODYNAMIC			V	M	S
1351	07	VELOCITY			V		
1351	09	VISCOUS			V		S
1351	10	WALL	N	T		M	S
1360	07	AERODYNAMIC			V		S
1360	10	AFTERBODY	N		V	M	S
1360	09	ANALYSIS	N		V		S
1360	09	ANGLE			V		S
1360	09	APPROXIMATION	N		V	M	S
1360	09	ATTACK	N				S
1360	08	BOATTAIL	N		V		S
1360	10	BODY		T	V		S
1360	09	CENTRE					S
1360	07	CENTRIFUGAL			V		
1360	09	CIRCULAR			V	M	
1360	09	COEFFICIENT	N			M	S
1360	09	CONE	N		V	M	S
1360	09	CYLINDER	N		V	M	S
1360	07	EXPANSION			V		S
1360	09	EXPERIMENTAL			V	M	S
1360	09	FLOW	N	T	V	M	S
1360	09	FORCE	N			M	S
1360	09	HYPERSONIC		T	V	M	S
1360	08	IMPACT			V		S
1360	10	LIFT	N	T	V		S
1360	09	MACH	N		V		S
1360	10	MISSILE	N		V		S
1360	09	MODERATE					S
1360	08	NEWTONIAN			V		S
1360	09	NORMAL			V	M	S
1360	09	OGIVE	N			M	S
1360	07	PREDICTION	N		V		S
1360	09	PRESSURE	N		V		

1360	07	REGION	N		V	M	S
1360	09	RESULT	N			M	S
1360	10	REVOLUTION	N	T	V		
1360	09	SUPERSONIC			V		S
1360	10	WINGED			V	M	
1360	10	YAWED			V	M	S
1367	07	BEHAVIOUR	N		V	M	S
1367	08	CONTROL		T	V	M	
1367	05	DESIGN	N	T	V	M	
1367	09	DYNAMIC			V	M	S
1367	07	ESTIMATION	N				S
1367	07	LINEAR			V		
1367	10	LYAPUNOV	N	T	V	M	S
1367	09	METHOD		T	V		
1367	07	NONLINEAR			V	M	S
1367		NONSTATIONARY			V		S
1367	07	OPTIMIZATION	N			M	S
1367	06	RELAY			V		S
1367	09	SECOND		T	V	M	
1367	06	SERVO	N		V		
1367	10	STABILITY	N		V		S
1367	07	STATIONARY			V		S
1367	09	SYSTEM	N	T	V	M	S
1367	09	THEORY	N		V	M	S
1367	07	TRANSIENT			V		S
1378	09	BOUNDARY			V	M	S
1378	09	CALCULATION	N		V		S
1378	09	CONSTANT			V	M	S
1378	08	ENTHALPY	N		V	M	
1378	07	FACTOR	N		V		S
1378	09	FLAT			V	M	S
1378	09	FLOW	N		V	M	S
1378	10	FRICTION	N		V	M	
1378	09	HEAT		T	V	M	S
1378	09	HIGH		T	V		S
1378	09	LAMINAR			V	M	S
1378	09	LAYER			V	M	S
1378	09	NUMERICAL			V	M	S
1378	09	PLATE	N		V		S
1378	08	RECOVERY			V		S
1378	10	SKIN				M	S
1378	07	SPECIFIC			V		S
1378	09	SUPERSONIC			V		S
1378	09	TEMPERATURE	N			M	
1378	09	TRANSFER	N	T	V		S
1378	09	TURBULENT			V		S
1378	07	VARIATION	N		V	M	S
1378	09	WALL			V	M	S

1383	09	BOUNDARY		T	V	M	S
1383	09	COEFFICIENT	N		V		
1383	09	COMPRESSIBLE		T			
1383	09	DISTRIBUTION	N		V		S
1383	10	DRAG			V	M	S
1383	09	FLOW	N	T	V		S
1383	09	GRADIENT	N		V	M	S
1383	09	HEAT		T	V	M	S
1383	09	LAYER	N	T	V	M	
1383	09	PLANE	N	T	V	M	
1383	09	PRESSURE			V		
1383	09	SEMIINFINITE			V		S
1383	09	SOLUTION	N		V	M	S
1383	09	TEMPERATURE			V	M	
1383	09	TRANSFER	N	T	V	M	S
1383	09	VANISHING			V		
1383	09	VELOCITY			V		S
1383	09	VISCOUS			V	M	S
1399	10	COMPOSITE		T	V	M	S
1399	09	CONDUCTION	N			M	
1399	10	HEAT			V		S
1399	10	SLAB		T			S
1399	09	THEORY	N			M	S
1399	09	TRANSIENT				M	
1399	10	WALL	N		V		S
1406	08	AERODYNAMIC			V	M	S
1406	07	AMBIENT			V		S
1406	09	BEHAVIOUR	N	T	V		S
1406	09	BOUNDARY		T	V		S
1406	07	COMPRESSIBLE			V		S
1406	05	CONDITION	N		V		S
1406	08	DISPLACEMENT			V		S
1406	08	DISSOCIATION	N		V		S
1406	08	DRAG	N		V		S
1406	06	EMISSIVITY	N		V	M	S
1406	08	ENTHALPY	N		V	M	S
1406	07	EQUILIBRIUM			V		
1406	09	FLAT			V	M	
1406	09	FLOW	N		V		S
1406	10	FRICTION	N		V	M	S
1406	09	GRADIENT	N		V	M	S
1406	09	HEAT			V		S
1406	08	HEATING	N		V	M	S
1406	05	HIGH			V		S
1406	07	HYPERSONIC			V	M	
1406	07	INTERMEDIATE			V	M	S
1406	09	LAMINAR			V	M	S
1406	09	LAYER	N	T	V	M	
1406	09	MAXIMUM			V	M	S
1406	07	MEAN				M	S
1406	09	PLATE	N		V	M	S
1406	09	PRESSURE			V		S

1406	06	RADIATIVE			V		S
1406	09	SELFINDUCED			V	M	S
1406	10	SKIN			V	M	S
1406	09	SUPERSONIC		T	V	M	S
1406	05	SURFACE			V	M	S
1406	09	TEMPERATURE	N		V	M	S
1406	09	THICKNESS	N		V	M	S
1406	09	TRANSFER	N				S
1406	09	TURBULENT			V	M	S
1406	09	ZERO			V	M	S
1409	10	AEROFOIL	N		V	M	
1409	10	BASE		T	V	M	S
1409	10	BLEED				M	S
1409	10	BLUNT			V		
1409	09	CALCULATION	N				S
1409	08	COMPRESSIBLE				M	
1409	07	CONSTANT			V	M	
1409	10	EDGE				M	S
1409	09	ENGINE	N		V		S
1409	09	EXTERNAL		T			S
1409	09	FLOW	N			M	S
1409	10	INTERACTION		T	V	M	
1409	10	INTERFERENCE					S
1409	08	ISOENERGETIC				M	S
1409	10	JET		T			S
1409	08	MIXING	N		V		
1409	10	PRESSURE	N	T	V	M	S
1409	08	ROCKET	N		V	M	
1409	10	SLIPSTREAM			V	M	S
1409	09	SONIC		T	V	M	S
1409		STREAM	N	T		M	S
1409	09	SUPERSONIC		T		M	S
1409	10	TRAILING				M	S
1409	08	TURBULENT			V		S
1409	10	TWODIMENSIONAL				M	
1409	10	WAKE	N		V		S
1415	08	BOUNDARY			V		S
1415	08	BUFFETING	N		V	M	S
1415	08	CAMBER			V		S
1415	10	AERODYNAMIC		T	V		S
1415	08	CHORDWISE					S
1415	06	CIRCULATION			V	M	S
1415	07	COEFFICIENT	N		V		S
1415	06	CONTROL	N		V		S
1415	10	CRUISING			V	M	
1415	10	DESIGN	N	T		M	S
1415	08	DISTRIBUTION	N		V		S
1415	08	DRAG	N		V	M	S
1415	08	EDGE	N		V		S
1415	09	FINITE			V		S
1415	06	FLAP	N		V		S
1415	07	FLOW	N		V	M	S

1415	08	FURM			V	M	S
1415	08	GROWTH	N		V	M	S
1415	08	INDUCED			V		S
1415	06	JET			V	M	S
1415	06	LAMINARIZATION	N		V	M	
1415	08	LAYER			V	M	
1415	08	LIFTING			V	M	
1415	08	LOADING	N		V		S
1415	08	ONSET	N		V	M	S
1415	08	PEAKY			V	M	S
1415	09	PERFORMANCE	N		V	M	S
1415	07	PREDICTION	N		V	M	S
1415	08	PRESSURE			V		S
1415	07	REQUIREMENT	N		V	M	S
1415	08	RISE	N		V		S
1415	08	ROOFTOP			V	M	S
1415	10	SECTION	N	T	V		S
1415		SEPARATION	N		V	M	S
1415	10	SHAPE	N	T	V	M	S
1415	08	SHOCK				M	S
1415	08	SPOILER	N		V	M	S
1415	07	STRUCTURAL			V		S
1415	08	SUPERSONIC			V		
1415	08	SURFACE					S
1415	09	SWEPT		T	V	M	S
1415	08	THICK			V	M	S
1415	08	THICKNESS				M	S
1415	06	THWAITES			V	M	S
1415	08	TRAILING					S
1415	08	TRANSONIC			V		S
1415	07	UPPER			V		S
1415	08	VELOCITY			V	M	
1415	08	WAVE			V	M	S
1415	10	WING	N	T	V		S
1416	07	AEROFOIL			V		S
1416	08	AIR			V	M	S
1416	09	AIRCRAFT	N		V	M	S
1416	06	BIPLANE			V		S
1416	06	BLADE			V		S
1416	08	BLOWING	N		V	M	S
1416	09	BOUNDARY	N	T	V	M	S
1416	08	BUFFETING	N	T	V	M	S
1416	06	BUMP			V	M	S
1416	07	COMPLETE			V	M	S
1416	09	CONTROL	N	T	V	M	S
1416	06	CORNER	N		V	M	S
1416	08	COROTATING				M	S
1416	08	COUNTERROTATING			V	M	S
1416	10	DELAY	N		V	M	S
1416	06	DESIGN	N		V	M	S
1416		DISTRIBUTED			V		S
1416	08	DIVERGENCE	N		V		S
1416	08	DRAG			V		S
1416	08	EDGE			V	M	S
1416	07	EXPERIMENT	N		V		S
1416	08	GENERATORS	N		V	M	S

1416	08	HALF			V		S
1416	10	HIGH			V	M	S
1416	10	INDUCED		T	V		
1416	08	JET			V		S
1416	09	LAYER		T		M	S
1416	06	MULTIPLE			V	M	S
1416	08	ONSET			V		S
1416	06	PATH	N		V	M	S
1416	07	PHOTOGRAPH	N		V		S
1416	08	POSITION	N			M	
1416	08	PRESSURE			V	M	S
1416	06	RAMP			V	M	S
1416	08	RISE	N		V	M	S
1416	06	ROW	N		V		S
1416	06	SCALE	N		V	M	S
1416	07	SCHLIEREN			V	M	S
1416	09	SEPARATION	N	T	V	M	
1416	10	SHOCK		T	V		S
1416	08	SLOT			V	M	S
1416	09	SPEED					S
1416	06	STRENGTH	N		V		S
1416	06	STRIP			V	M	S
1416	05	SUCTION	N		V	M	S
1416	06	SWEPTBACK			V	M	
1416	08	TECHNIQUE	N		V	M	S
1416	08	TRAILING			V	M	
1415	07	TUNNEL			V		S
1416	06	TWISTED			V		S
1416	06	TYPE			V		S
1416	08	VANE			V		S
1416	08	VELOCITY			V	M	
1416	08	VORTEX	N		V	M	S
1416	06	WEDGE			V		
1416	07	WIND			V		S
1416	06	WING	N		V		S
1420	09	ANGLE	N		V	M	S
1420	09	ASPECT			V	M	
1420	09	ATTACK	N		V	M	S
1420	08	CONICAL			V		
1420	10	DELTA		T	V	M	S
1420	08	DISTRIBUTION	N				S
1420	08	DRAG			V		S
1420	08	EDGE		T	V	M	S
1420	10	EDGED	N		V	M	S
1420	09	EXPERIMENT	N			M	S
1420	09	FIELD	N	T	V	M	S
1420	09	FLOW	N	T	V		S
1420	09	HIGH			V	M	S
1420	08	LEADING		T	V		S
1420	08	LOCATION	N		V	M	S
1420	09	NARROW			V	M	S
1420	08	PATH			V	M	S
1420	07	POSITION	N		V	M	
1420	08	PRESSURE			V	M	
1420	09	RATIO	N		V	M	S
1420	08	REYNOLDS	N		V		S

1420	08	RISE	N		V		S
1420	08	ROOT			V		S
1420		SECTION	N		V	M	S
1420	08	SEPARATION	N		V	M	S
1420	10	SHARP		T	V	M	S
1420	08	SHEET			V		
1420	08	STALLED			V	M	S
1420	09	SURFACE	N				S
1420	08	SWEEP			V		S
1420	10	SWEPT		T	V		
1420	08	TRANSONIC					S
1420	09	TUNNEL			V	M	
1420	10	TURBULENT			V		S
1420	09	UPPER					S
1420	08	VELOCITY					
1420	08	VORTEX			V	M	S
1420	08	VORTICITY	N		V		S
1420	09	WIND			V	M	S
1420	10	WING	N	T	V	M	S
1436	10	ATMOSPHERE	N	T	V		S
1436	09	BOUNDARY				M	
1436	08	CONVECTIVE			V		S
1436	10	ENTHALPY	N		V		S
1436	07	FLIGHT			V	M	S
1436	09	HEAT		T	V	M	S
1436	10	IONIZED				M	S
1436	09	LAYER	N		V	M	
1436	10	PLANETARY		T	V	M	S
1436	09	POINT				M	S
1436	07	PRESSURE	N		V	M	
1436	08	RADIATION				M	S
1436	09	SPEED	N	T	V		S
1436	10	STAGNATION				M	S
1436	10	SUPERSATELLITE			V		
1436	08	TEMPERATURE	N				S
1436	09	THEORY	N		V		
1436	09	TOTAL			V		S
1436	09	TRANSFER	N	T	V		S
1436	10	VEHICLE	N		V	M	S
1436	07	VELOCITY	N				S
1436	08	WALL			V	M	S
1437	07	AIR	N	T	V	M	S
1437	09	ANALYSIS	N		V		
1437	06	BOUNDARY				M	S
1437	06	CHARGED			V	M	S
1437	09	CONVECTIVE			V		S
1437	09	DATA	N			M	S
1437	06	DIFFUSION	N		V	M	S
1437	07	DISSOCIATED		T	V	M	S
1437	09	ESCAPE			V	M	S
1437	09	EXPERIMENTAL				M	
1437	10	FLOW				M	

1437	06	GAS			V		
1437	10	HEAT		T	V		
1437	10	HYPERSONIC			V		S
1437	10	HYPERVELOCITY	N	T	V	M	S
1437	10	IONIZATION			V	M	S
1437	06	LAMINAR					S
1437	06	LAYER	N		V		S
1437	09	MACH	N		V	M	S
1437	06	MIXTURE	N		V		S
1437	06	PARTICLE	N		V	M	SA
1437	10	POINT		T	V		S
1437	09	REENTRY					
1437	09	SHOCK			V	M	S
1437	10	STAGNATION		T		M	S
1437	09	THEORETICAL			V	M	S
1437	10	TRANSFER	N	T	V		S
1437	09	TUBE	N			M	
1437	09	VELOCITY	N		V		S
1443	07	ANGLE			V	M	S
1443	07	ATTACK	N		V		S
1443	05	CHORD			V	M	S
1443	05	CIRCULATION	N		V	M	S
1443	05	COEFFICIENT	N		V		S
1443	09	DENSITY			V		S
1443	09	DISTRIBUTION	N	T	V		S
1443	07	FLOW			V	M	S
1443	05	FORCE			V	M	S
1443	08	LIFT	N		V	M	S
1443	06	MANOMETER	N		V	M	S
1443	09	MEASUREMENT	N		V	M	S
1443	09	MODEL	N		V	M	S
1443	05	MOMENT			V		S
1443	06	MULTIPLE			V	M	S
1443	05	NORMAL			V	M	S
1443	06	PHOTORECORDING			V	M	S
1443	06	PITCHING			V	M	S
1443	08	POTENTIAL			V		S
1443	09	RECTANGULAR			V		S
1443	05	REDUCTION			V	M	S
1443	07	THEORY	N		V		
1443	06	TUBE			V	M	S
1443	09	TUNNEL	N		V		S
1443	09	VARIABLE			V		S
1443	09	WIND			V	M	S
1451	06	ASYMPTOTIC			V		S
1451	10	AUTOMATIC		T	V	M	S
1451	06	AUTOPILOT			V		S
1451	06	BANGBANG			V		S
1451	06	COEFFICIENT	N		V	M	S
1451	06	CONSTANT				M	S
1451	10	CONTROL	N	T	V		
1451	06	CRITERION			V		S

1451	06	CYCLES	N		V		S
1451	09	DIFFERENTIAL			V		S
1451	06	DISTURBANCE	N		V	M	A
1451	09	EQUATION	N			M	S
1451	05	ESTIMATION	N				S
1451	06	FEEDBACK	N		V		S
1451	06	LIMIT			V		S
1451	06	LINEAR			V		S
1451	08	LINEARIZATION	N		V	M	S
1451	10	LYAPUNOV		T	V	M	SA
1451	07	MECHANICS	N		V	M	S
1451	04	MISSILE			V	M	S
1451	06	MOTION	N		V	M	S
1451	10	NONLINEAR			V		S
1451	06	OSCILLATORY			V	M	S
1451	06	PERIODIC				M	S
1451	06	PHASE			V		S
1451	06	PITCH			V	M	S
1451	04	PROBE	N		V		S
1451	06	RANDOM			V	M	S
1451	06	ROLL	N		V	M	S
1451	06	ROUTTHURWITZ			V	M	S
1451	06	SOLUTION	N		V	M	S
1451	06	SPACE	N			M	S
1451	10	STABILITY	N		V	M	S
1451	06	STABLE			V	M	S
1451	06	STATE			V	M	S
1451	09	THEORY	N	T	V		S
1451	06	TIMEOPTIMUM			V	M	
1451	06	TRAJECTORIES	N		V		S
1451	06	TRANSIENT			V	M	S
1451	06	YAW			V		
1467	08	ACCELERATING			V		S
1467	09	AEROFOIL	N	T	V		
1467	09	APPROXIMATE		T	V	M	S
1467	07	CALCULATION	N		V	M	
1467	08	DECELERATING			V	M	S
1467	08	DISTRIBUTION	N		V		S
1467	09	DISTURBANCE			V	M	
1467	08	DRAG	N		V		
1467	09	EQUATION	N	T	V		S
1467	09	FLOW	N	T	V	M	
1467	07	MACH	N		V		
1467	10	NONLIFTING			V		S
1467	09	NONLINEAR			V	M	
1467	07	PRESCRIBED			V	M	S
1467	09	PRESSURE			V		S
1467	08	SHAPE	N		V	M	S
1467	09	SMALL			V	M	S
1467	09	SOLUTION	N	T		M	S
1467	09	THEORY	N	T	V	M	S
1467	09	TRANSONIC		T	V		S
1467	09	TWODIMENSIONAL			V		S

1476	10	BLASIUS		T	V	M	S
1476	10	BOUNDARY		T			S
1476		CONDITION	N	T			
1476	09	EQUATION	N	T	V	M	
1476	10	FLOW	N				S
1476	10	INTERACTION	N			M	S
1476	10	ISOBARIC			V	M	S
1476	10	MIXING			V	M	
1476	10	PARALLEL				M	S
1476	09	POINT		T			
1476	09	SOLUTION	N		V	M	
1476	10	STREAMS	N				
1476	09	THREE		T			S
1509	09	APPROXIMATION	N	T			
1509	10	ATMOSPHERE	N			M	
1509	09	DISTRIBUTION	N			M	S
1509	10	EARTH			V	M	S
1509	10	EVAPORATION	N			M	S
1509	10	FREENTERING			V	M	
1509	09	GRAPHICAL		T	V	M	S
1509	09	GROSS		T		M	
1509	09	HEAT		T	V	M	
1509	09	LARGE		T		M	S
1509	09	NET		T	V	M	S
1509	10	POINT	N				
1509	10	PROTECTION				M	S
1509	10	QUARTZ			V	M	S
1509	09	RATE	N	T			
1509	10	SHIELD	N			M	
1509	09	SMALL		T	V		
1509	10	SPACE			V		
1509	10	STAGNATION			V		S
1509	10	SUBLIMATION		T	V	M	S
1509	09	SURFACE		T	V	M	
1509	09	TEMPERATURE		T			S
1509	09	TRANSFER		T	V		
1509	10	VEHICLE	N			M	S
1569	07	AVERAGE					S
1569	09	BOUNDARY		T		M	S
1569	07	COEFFICIENT	N			M	
1569	07	DEFICICIENCY			V		S
1569	06	DRAG	N		V		S
1569	10	EDGE	N	T	V		S
1569	08	EXPANSION			V	M	S
1569	10	FLAT			V	M	
1569	09	FLOW			V	M	S
1569	08	FRICTION			V	M	S
1569	08	GROWTH	N		V	M	S
1569	09	HYPERSONIC				M	S
1569	07	IMPACT			V	M	S
1569	09	INDUCED					S

1569	10	INTERACTION	N	T	V	M	S
1569	10	INVISCID			V		
1569	09	LAYER		T	V	M	S
1569	10	LEADING		T	V	M	S
1569	07	LOCATION	N				S
1569	10	MACH	N	T		M	
1569	09	MEASUREMENT	N		V	M	S
1569	07	MOMENTUM			V		
1569	07	NUMBER				M	S
1569	10	PLATE	N				
1569	09	PRESSURE	N		V		S
1569	07	PROFILE	N		V	M	S
1569	08	REFLECTED					SA
1569	10	SHARP			V		
1569	10	SHOCK		T	V	M	S
1569	08	SKIN			V	M	
1569	07	STRENGTH	N		V	M	S
1569	07	SURVEY	N			M	S
1569	05	TOTAL			V	M	S
1569	09	TUNNEL			V	M	S
1569	10	VISCID			V	M	S
1569	10	WAVE	N	T	V		S
1569	07	WIND			V		S
1572	06	AFTERBODY					S
1572	09	ANGLE				M	S
1572	07	ATTACK	N		V		S
1572	09	BLUNT			V	M	S
1572	06	BLUNTED			V	M	
1572	10	BLUNTNESS	N	T	V		S
1572	10	BODY	N		V	M	S
1572	09	BOUNDARY		T	V	M	S
1572	09	COMBINED				M	S
1572	08	CONTINUUM			V	M	
1572	06	DECAY	N				S
1572	08	DETACHED			V	M	S
1572	10	DISPLACEMENT	N	T	V		
1572	09	DISTRIBUTION	N		V		S
1572	09	DISTURBANCE				M	S
1572	07	DOWNSTREAM			V		S
1572	10	EDGE	N	T		M	
1572	09	EFFECT	N	T	V	M	S
1572	08	ENTROPY			V	M	S
1572	10	FLAT			V	M	
1572	09	FLOW	N	T		M	S
1572	09	HEAT			V	M	S
1572	09	HIGH		T		M	S
1572	09	HYPERSONIC		T	V	M	
1572	07	INCIDENCE	N		V		S
1572	07	INFLUENCE			V	M	S
1572	07	INNER			V	M	S
1572	10	INTERACTION					S
1572	10	INVISCID			V		S
1572	09	LAMINAR				M	S
1572	09	LAYER	N	T	V	M	S
1572	10	LEADING		T	V	M	S
1572	07	LOCAL			V	M	S

1572	10	MACH	N		V		S
1572	09	MEASUREMENT	N		V	M	S
1572	07	MODEL	N				S
1572	07	ORDER			V	M	S
1572	06	OSCILLATORY			V		S
1572	07	OUTER			V	M	
1572	10	PLATE	N		V	M	S
1572	07	PRESSURE	N		V	M	S
1572	09	RATE	N		V	M	S
1572	10	SHAPE	N		V	M	
1572	09	SHARP			V	M	
1572	10	SHOCK				M	S
1572	07	SIMILARITY			V	M	S
1572		SIMILITUDE	N		V		S
1572	09	SMALL				M	S
1572	07	SOLUTION	N		V		S
1572	07	STUDY	N		V		S
1572	09	SURFACE				M	S
1572	09	TEMPERATURE		T		M	S
1572	07	THEORETICAL			V	M	
1572	09	THEORY	N		V		S
1572	10	THIN			V	M	S
1572	10	TIP				M	S
1572	09	TRANSFER			V	M	S
1572	09	TUNNEL			V		S
1572	10	VISCID			V		S
1572	10	VISCOUS			V		
1572	10	WAVE			V		S
1572	06	WEDGE	N				S
1572	09	WIND			V		S
1572	07	ZERO			V	M	S
1574	09	ALTITUDE					S
1574	10	BLUNT				M	
1574	10	BODY	N			M	S
1574	09	CALCULATION	N			M	S
1574	10	CHEMICALLY				M	S
1574		CONDITION	N		V	M	S
1574	07	DENSITY			V	M	S
1574	08	DIATOMIC			V		S
1574	10	DISSOCIATION	N	T	V	M	S
1574	00	DISTRIBUTION	N	T	V	M	S
1574	06	EQUILIBRIUM			V	M	S
1574	08	EXPANSION			V		S
1574	09	FIELD	N				S
1574	09	FLIGHT	N	T	V		S
1574	09	FLOW	N	T		M	S
1574	08	FROZEN			V	M	S
1574	10	GAS	N		V		S
1574	09	HIGH					
1574	09	HYPERSONIC		T	V	M	
1574	07	INITIAL			V	M	
1574	10	INVISCID		T		M	
1574	08	MEYER			V		SA
1574	08	MIXTURE	N		V	M	
1574	08	MODEL			V	M	S
1574	10	MOLECULAR		T	V		

1574	08	NITROGEN			V		
1574	10	NONEQUILIBRIUM		T	V	M	S
1574	07	ONEDIMENSION			V	M	S
1574	08	OXYGEN			V		S
1574	08	PRANDTL			V	M	S
1574	09	PRESSURE		T	V	M	S
1574	10	REACTING			V	M	S
1574	07	REGION	N		V	M	
1574	08	STAGNATION					S
1574	10	STREAMLINE	N		V	M	S
1574	07	SUPERSONIC			V	M	S
1574	07	TEMPERATURE			V	M	S
1574	07	VELOCITY			V	M	S
1575	06	ADIABATIC			V		S
1575	06	ANGLE	N		V		S
1575	10	ATOMIC		T	V		S
1575	06	BEHIND				M	S
1575	06	BLUNT			V	M	S
1575	06	BODY	N		V		S
1575	05	CALCULATION	N		V		S
1575	08	CHEMICAL					S
1575	07	CONDITION	N		V		S
1575	09	CONICAL				M	S
1575	06	CONVERGENT			V	M	S
1575	06	DENSITY	N		V		
1575	08	DEVIATION			V		S
1575	10	DISSOCIATING			V		S
1575	10	DISSOCIATION	N		V		S
1575	05	DISTANCE	N				S
1575	06	DIVERGENT					S
1575	06	DRAG	N		V	M	S
1575	09	EQUATION	N		V	M	S
1575	08	EQUILIBRIUM	N		V	M	S
1575	09	FINITE			V		S
1575	09	FLOW	N		V	M	
1575	05	FRACTION	N		V		S
1575	10	FREEZING			V		S
1575	06	FRICTIONLESS			V	M	S
1575	10	GAS	N		V	M	S
1575	05	HEAT			V		S
1575	09	HYPERSONIC		T	V	M	S
1575	10	IDEAL			V	M	S
1575	06	MACH			V		S
1575	10	MOLECULAR			V	M	S
1575	09	NEARLY			V	M	S
1575	06	NITROGEN	N		V	M	S
1575	10	NOZZLE	N	T	V	M	S
1575	06	ONEDIMENSIONAL			V		S
1575	06	OPTIMUM				M	S
1575	06	OXYGEN	N		V	M	S
1575	10	PHENOMENA	N		V	M	S
1575	05	PRESSURE	N			M	S
1575	06	QUASI			V		S
1575	06	RATE	N			M	
1575	06	REACTION	N		V	M	
1575	10	RECOMBINATION	N	T	V	M	SA

1575	10	RELAXATION			V	M	S
1575	06	ROCKET			V		S
1575	06	SECTION	N		V	M	S
1575	06	SHAPE	N		V	M	S
1575	06	SHOCK			V	M	S
1575	09	SOLUTION	N		V		S
1575	08	SPHERE	N		V	M	S
1575	08	STAGNATION			V		S
1575	06	STANDOFF				M	S
1575	05	TEMPERATURE	N		V	M	
1575	05	TEST			V		S
1575	05	TRANSFER			V		
1575	06	TUBE	N		V		S
1575	09	TUNNEL		T	V		S
1575	05	VISCOSITY	N		V		S
1575	06	WAVE	N			M	S
1575	09	WIND		T			S
1575	06	WORKING			V	M	S
1576	07	AHEAD					S
1576	08	AIR			V	M	S
1576	08	AMBIENT			V		S
1576	09	ANALYSIS	N		V	M	S
1576	08	APPROCACHING			V	M	S
1576	06	ATOM			V	M	S
1576	08	ATOMIC			V		S
1576	08	BLOW			V	M	S
1576	10	BLUNT			V	M	
1576	10	BODY	N		V		
1576	08	BOUNDARY			V	M	S
1576	08	BOW			V		S
1576	08	CHEMICALLY			V		S
1576	08	DENSITY			V	M	S
1576	08	DETACHMENT			V	M	
1576	10	OISSOCIATED		T	V	M	S
1576	08	DISSOCIATION	N		V		S
1576	08	DISTANCE	N		V		S
1576	06	ENERGY	N		V		S
1576	08	EQUILIBRIUM			V	M	
1576	09	FLOW	N	T	V	M	S
1576	06	FRACTION	N		V	M	S
1576	09	FREE		T	V	M	S
1576	08	FROZEN			V		S
1576	05	FUNCTION			V	M	S
1576	08	GAS	N		V	M	S
1576	07	GEOMETRY	N		V	M	S
1576	08	HEAT			V		
1576	09	HIGH			V		S
1576	10	HYPERSONIC				M	
1576	07	INITIALLY			V	M	S
1576	08	INVISCID		T	V	M	S
1576	08	IONIZATION	N		V		S
1576	08	LAYER			V	M	S
1576	06	MASS			V	M	S
1576	08	NITROGEN			V	M	
1576	08	NONCATALYTIC			V	M	S
1576	10	NONEQUILIBRIUM			V	M	S

1576	10	NOSED			V	M	S
1576	09	NUMBER			V	M	S
1576	08	OXYGEN			V	M	S
1576	07	PROPERTY			V		S
1576	07	RATIO	N		V		S
1576	09	REYNOLDS			V		S
1576	08	SHOCK	N		V		S
1576	10	STAGNATION		T		M	S
1576	08	STANDOFF			V		S
1576	07	STATE	N			M	S
1576	09	STREAM	N	T		M	S
1576	08	SURFACE	N		V	M	S
1576	08	TEMPERATURE	N		V		S
1576	08	THICKNESS	N			M	S
1576	07	TRANSFER	N		V	M	S
1576	08	UNDISSOCIATED				M	S
1576	08	VIBRATIONALLY	N		V	M	S
1576	09	VISCOUS		T	V	M	S
1578	08	AIR				M	S
1578	10	ALTITUDE			V	M	S
1578	10	BLUNT		T		M	S
1578	10	BODY	N		V	M	S
1578	01	CHEMICAL			V		
1578	07	CORRELATED			V	M	S
1578	10	DISSOCIATING			V	M	
1578	10	DISSOCIATION		T		M	S
1578	07	DISTANCE	N			M	S
1578	07	DISTRIBUTION	N		V	M	S
1578	09	FLIGHT	N				S
1578	09	FLOW	N	T			S
1578	10	GAS	N		V		S
1578	09	HIGH				M	S
1578	09	HYPERSONIC				M	S
1578	10	IDEAL			V	M	S
1578	10	INVISCID					
1578	10	LAW	N		V	M	S
1578	10	MODEL			V		S
1578	10	NONEQUILIBRIUM		T		M	
1578	10	NOSED		T	V	M	
1578	10	RECOMBINATION	N			M	S
1578	10	SCALING	N	T		M	S
1578	08	SHOCK				M	S
1578	08	STANDOFF			V		
1578	07	TEMPERATURE					S
1578	10	VISCOUS					S
1588	06	ABRUPT			V	M	
1588	06	ADJUSTABLE			V	M	
1588	06	AIR			V		S
1588	09	ANALYSIS	N		V		S
1588	10	AXIAL		T	V	M	S
1588	06	BAFFLES	N			M	S

1588	10	BLADE		T	V		
1588	06	BLADING	N		V		S
1588	06	BLEED	N		V	M	S
1588	09	CHARACTERISTIC	N		V	M	S
1588	06	CIRCUMFERENTIAL				M	S
1588	06	COEFFICIENT	N		V		S
1588	08	COMPLETE			V		S
1588	10	COMPRESSOR	N	T	V	M	S
1588	09	DISCONTINUITY					S
1588	08	DISTRIBUTION					S
1588	05	EFFECT	N		V	M	S
1588	09	EFFICIENCY	N				S
1588	08	FIRST			V		S
1588	10	FLOW	N	T	V	M	S
1588	08	FRONT			V		S
1588	06	GUIDE					S
1588	10	HIGH			V	M	S
1588	06	HYSTERESIS					S
1588	08	INLET					S
1588	08	INTERACTION	N		V	M	S
1588	08	INTERMEDIATE				M	S
1588	08	LIMIT			V	M	S
1588	08	LINE	N		V	M	S
1588	08	LOW			V		S
1588	08	MATCHING	N		V	M	S
1588	10	MULTISTAGE			V	M	S
1588	09	OPERATION	N	T			S
1588	10	PART			V	M	S
1588	09	PERFORMANCE	N				S
1588	10	PRESSURE			V		S
1588	06	PROGRESSIVE			V	M	S
1588	06	RADIAL			V	M	S
1588	10	RATIO			V	M	S
1588	10	RAW	N		V	M	S
1588	06	ROTATING			V	M	
1588	08	SINGLE			V		S
1588	10	SPEED	N		V		S
1588	08	STACKING					S
1588	08	STAGE	N		V	M	S
1588	10	STALL	N		V		
1588	08	STALLED	N		V	M	S
1588	10	STALLING	N		V	M	S
1588	08	SURGE	N				S
1588	06	TRANSITION	N		V		S
1588	07	TYPE			V	M	S
1588	08	UNSTALLED	N		V	M	S
1588	06	UNSTEADY			V	M	S
1588	06	VANE	N		V		S
1589	07	ANALYSIS	N				S
1589	10	ANEMOMETER	N		V	M	
1589	10	AXIAL		T	V		S
1589	08	BLADE				M	S
1589	07	CHARACTERISTIC	N		V	M	S
1589	10	COMPRESSOR	N	T		M	
1589	08	DISCONTINUITY	N		V	M	S
1589	07	EQUIVALENT				M	S
89	07	FAILURE	N				S
89	09	FLOW		T	V		S

1589	09	HOT			V		
1589	09	INVESTIGATION	N		V		S
1589	10	MULTISTAGE				M	S
1589	07	PERFORMANCE	N		V		
1589	07	PRESSURE			V	M	S
1589	07	PROGRESSIVE			V	M	S
1589	07	RATIO			V	M	S
1589	08	RESONANT			V	M	S
1589	08	ROOT			V	M	S
1589	10	ROTATING				M	
1589	09	SINGLE			V		S
1589	08	STACKING			V		S
1589	10	STAGE			V	M	S
1589	10	STALL	N	T	V	M	S
1589	10	SURGE	N	T			S
1589	08	TIP			V	M	S
1589	08	VIBRATION	N		V		S
1589	08	WEIGHT			V	M	S
1589	09	WIRE			V	M	S
1590	09	ANALYSIS	N		V		S
1590	06	ANGLE	N		V		S
1590	06	ANNULUS			V	M	S
1590	06	AREA	N		V		S
1590	10	AXIAL		T	V		S
1590	06	BLADE			V		S
1590	06	CASCADE			V	M	S
1590	06	CHANGE			V		S
1590	10	CHARACTERISTIC	N	T	V		S
1590		CHOKING			V		S
1590	06	COEFFICIENT	N		V	M	S
1590	10	COMPRESSOR	N	T	V		S
1590	06	CONSTANT			V	M	S
1590	06	CURVE	N		V	M	S
1590	05	DATA	N		V	M	
1590	08	DESIGN	N		V		S
1590	07	DISTRIBUTION	N			M	S
1590	06	DOUBLE			V		S
1590	09	FLOW	N	T	V	M	S
1590	06	GUIDE			V	M	S
1590	06	HYSTERESIS	N		V	M	S
1590	08	IDEALIZED			V	M	S
1590	06	INLET			V	M	S
1590	06	KNEE	N		V		S
1590	06	LINE	N		V		S
1590	06	LOADING	N		V	M	
1590	06	LOSS	N			M	S
1590	07	MACH			V	M	S
1590	08	MASS			V		S
1590	10	MATCHING	N	T	V	M	S
1590	07	NUMBER	N		V		S
1590	06	ONE	N		V		S
1590	08	OPERATION	N			M	S
1590	08	PERCENTAGE				M	
1590	10	PERFORMANCE	N	T	V	M	
1590	06	PITCH			V		S

1590	08	POINT	N				S
1590	07	PRESSURE			V		S
1590	08	RANGE			V		S
1590	09	RATIO	N		V		S
1590	08	SLOPE			V	M	S
1590	08	SPEED	N		V	M	S
1590	10	STAGE		T	V	M	S
1590	06	STAGGER	N		V	M	S
1590	08	STALLING				M	
1590	08	SURGE	N		V		
1590	06	TEMPERATURE			V	M	S
1590	05	TEST			V		S
1590	05	TOTAL			V		S
1590	06	TWO	N		V	M	
1590	06	UNSTALLING			V	M	S
1590	06	UPRATING			V		S
1590	06	VALUED			V		S
1590	06	VANE			V	M	S
1590	07	VELOCITY			V		S
1591	09	APPROXIMATE		T	V		S
1591	10	CHOKE		T	V	M	S
1591	10	COMPRESSION				M	
1591	10	COMPRESSOR	N	T			
1591	09	EQUATION	N	T		M	S
1591	09	FLOW	N				S
1591	10	ISENTROPIC			V		
1591	09	LINE	N	T		M	S
1591	10	NOZZLE	N			M	
1591	10	SONIC					S
1591	10	THROAT			V		S
1591	09	VELOCITY	N		V	M	
1592	08	AIR			V		S
1592	07	ANGLE	N		V	M	S
1592	10	AXIAL		T	V	M	S
1592	08	BENDING			V	M	
1592	08	BLADE	N		V		S
1592	08	BLADING	N		V		S
1592	07	COEFFICIENT	N		V		S
1592	10	COMPRESSOR	N	T		M	S
1592	07	CONSTANT			V		S
1592	05	CONSTRUCTION	N			M	S
1592	09	CURVE	N		V	M	S
1592	09	DESIGN	N	T	V	M	S
1592	06	DISK			V	M	
1592	07	EFFICIENCY	N		V	M	S
1592	07	FLOW			V		S
1592	07	FORM	N		V	M	S
1592	07	FREE			V	M	S
1592	09	GENERALIZED			V	M	S
1592	08	IMPULSE			V	M	S
1592	06	JUMO	N		V	M	S
1592	07	OUTLET			V		S

1592	08	REACTION			V		
1592	07	RISE	N		V	M	S
1592	08	ROTOR			V		S
1592	08	STAGE			V		S
1592	08	STATOR			V	M	S
1592	08	STRESS	N		V		S
1592	07	TEMPERATURE			V		S
1592	08	VORTEX			V		S
1594	09	AERODYNAMIC			V		S
1594	06	AMPLITUDE			V	M	S
1594	07	CIRCUIT	N		V	M	
1594	07	COUPLED			V	M	S
1594	08	DAMPING			V	M	S
1594	08	DAMPOMETER	N				S
1594	08	DECAYING			V		S
1594	09	DEGREE			V		
1594	10	DERIVATIVE	N	T	V	M	S
1594	09	DIRECT			V	M	S
1594	10	DISPLACEMENT	N		V		S
1594	08	DRIVE	N		V	M	S
1594	08	ELASTIC			V	M	S
1594	08	ELECTRICAL					S
1594	08	ELECTRICALLY			V	M	S
1594	08	EXCITATION	N		V		S
1594	08	EXCITED			V	M	S
1594	07	EXTERNAL			V		S
1594	08	FLUTTER			V		
1594	06	FORCE			V	M	S
1594	08	FORCING			V	M	S
1594	07	FREE			V	M	S
1594	10	FREEDOM	N			M	S
1594	06	FREQUENCY			V	M	S
1594	08	INDIRECT			V	M	S
1594	08	INEXORABLE			V	M	S
1594	07	INTEGRATION			V	M	S
1594	07	INTERNAL			V		S
1594	08	LOGARITHMIC			V	M	S
1594	09	MEASUREMENT	N	T	V	M	S
1594	07	METHOD	N		V		S
1594	10	OSCILLATION	N				S
1594	08	OSCILLATORY		T	V		S
1594	08	PHASE			V	M	S
1594	06	PICKUP	N			M	S
1594	09	PITCH			V	M	S
1594	07	PLOTTING	N		V	M	S
1594	07	PRESSURE			V	M	S
1594	07	REACTION	N		V	M	
1594	08	RESONANCE	N		V		
1594	09	RIGID			V	M	S
1594	07	SELF			V	M	S
1594	10	SINUSOIDAL			V	M	S
1594	08	STIFFNESS			V	M	S
1594	09	TRANSLATION	N		V		S
1594	09	TUNNEL		T	V		S
1594	09	VERTICAL			V		S
1594	06	WALL	N		V	M	S

1594	09	WIND		T	V	M	S
1594	09	WING	N		V	M	S
1596	09	ANALYSIS	N			M	
1596	09	APPLIED					
1596	08	BENDING	N		V		S
1596	08	CENTRE				M	S
1596	08	COMPRESSION	N		V	M	S
1596	10	CROSSED		T			S
1596	10	CROSSING					S
1596	06	DESIGN	N		V		S
1596	09	DETERMINATION	N		V	M	
1596	08	DISPLACED			V		S
1596	10	FLEXURE		T	V		S
1596	09	FORCE			V		
1596	09	LOAD	N		V		S
1596	05	MAXIMUM			V		
1596	07	NONLINEAR					S
1596	10	PIVOT	N	T	V	M	S
1596	10	POINT	N		V	M	S
1596	09	PROPERTY	N		V	M	
1596	07	RELATION	N	T			S
1596	08	ROTATION	N	T	V		S
1596	10	ROTATIONAL			V		S
1596	10	STIFFNESS	N		V	M	S
1596	06	STRESS	N		V		S
1596	10	STRIP	N				S
1596	08	TENSION	N		V	M	S
1596	08	TORQUE	N	T	V	M	S
1597	06	AERODYNAMIC			V	M	
1597	09	AEROFOIL	N	T	V	M	S
1597	10	BLUNT		T	V		S
1597	10	BLUNTING	N		V	M	S
1597	08	CHORD					S
1597	06	DAMPING				M	S
1597	10	DERIVATIVE	N	T		M	S
1597	06	EQUIPMENT	N		V	M	S
1597	09	FLOW	N	T	V	M	S
1597	06	FREQUENCY			V	M	
1597	08	GEAR	N				
1597	06	LESS	N		V		S
1597	08	MACH	N			M	S
1597	09	MEASUREMENT	N	T	V	M	S
1597	08	MODEL	N		V	M	S
1597	10	MOMENT		T	V		S
1597	10	NOSE		T	V		
1597	10	NOSED			V	M	S
1597	10	OSCILLATING	N	T	V		S
1597	06	PARAMETER			V	M	S
1597	06	PERCENT	N		V		S
1597	06	PISTON			V	M	
1597	10	PITCHING		T	V	M	S
1597	08	RATIO			V	M	

1597	08	SINGLE					
1597	06	STIFFNESS				M	
1597	09	SUPERSONIC		T	V		S
1597	08	SUPPORT			V		S
1597	05	THEORY	N				S
1597	08	THICKNESS			V		S
1597	07	TUNNEL	N		V	M	S
1597		TWODIMENSIONAL		T	V	M	
1597	08	WEDGE			V	M	
1597	07	WIND			V		
1598	09	AERODYNAMIC			V		S
1598	09	ARC			V		S
1598	06	BLUNT			V		S
1598	06	CONTROL				M	
1598	10	DAMPING	N		V	M	S
1598	09	DERIVATIVE	N				S
1598	09	DISCHARGE	N		V	M	S
1598	09	DYNAMIC				M	S
1598	10	EXHAUST				M	
1598	06	FLAP	N		V		S
1598	07	FLOW			V	M	S
1598	10	HYPERVELOCITY		T	V	M	S
1598	10	JET	N		V		S
1598	09	MEASUREMENT	N		V		S
1598	06	REENTRY				M	S
1598	10	ROCKET			V		S
1598	08	SEPARATION	N			M	S
1598	09	SIMULATION	N		V	M	S
1598	10	STABILITY	N		V	M	S
1598	09	STRUCTURAL			V		S
1598	09	TUNNEL		T	V	M	S
1598	10	VEHICLE	N		V		S
1598	09	WIND		T		M	
1605	10	BLUNTED			V	M	S
1605	10	CONE		T	V	M	S
1605	10	CONFIGURATION	N	T		M	S
1605	10	CYLINDER		T			
1605	10	FLARE		T	V	M	S
1605	09	FLOW			V	M	
1605	09	HYPERSONIC					
1605	09	IMPACT			V		
1605	09	INCIDENCE	N	T			S
1605	10	MACH	N	T	V		S
1605	09	MEASUREMENT	N	T		M	S
1605	10	NEWTONIAN				M	S
1605	10	NODE	N		V	M	S
1605	10	PRESSURE	N	T			
1605	10	SLENDER			V	M	
1605	09	SLIGHTLY				M	
1605	08	STATIC				M	
1605	10	SURFACE			V	M	S
1605	09	THEORY			V	M	S
1605	09	TUNNEL				M	S
1605	09	WIND				M	S

1606	10	AERODYNAMIC		T			S
1606	07	ALTITUDE	N		V	M	
1606	07	ANALYTICAL			V		S
1606	09	APPROXIMATION	N	T	V	M	S
1606	10	BODY	N		V	M	S
1606	07	BOUNDARY			V	M	S
1606	07	EFFECT	N				
1606	10	ENTHALPY				M	S
1606	07	EQUILIBRIUM			V	M	
1606	09	ESTIMATE	N		V		S
1606	07	ESTIMATION	N		V		S
1606	10	FLIGHT	N	T	V	M	S
1606	07	FLOW	N		V		S
1606	07	FUSED			V	M	S
1606	07	HEAT			V	M	
1606	10	HEATING		T	V		S
1606	09	INTERMEDIATE			V		S
1606	07	LAMINAR			V	M	S
1606	07	LAYER	N		V		S
1606	07	LOCAL			V	M	S
1606	07	MACH			V	M	S
1606	07	MILD			V	M	S
1606	07	NUMBER	N		V		S
1606	08	RADIATION			V		S
1606	07	RATE	N	T	V	M	S
1606	07	REYNOLDS			V	M	S
1606	07	SILICA				M	S
1606	08	SKIN	N		V		S
1606	10	SLENDER			V		S
1606	07	STEEL				M	S
1606	07	STRUCTURE	N		V	M	S
1606	09	SUPERSONIC			V	M	S
1606	07	SURFACE			V	M	S
1606	07	TEMPERATURE	N			M	
1606	07	THICK			V		S
1606	07	THIN			V		S
1606	07	TIME			V	M	S
1606	08	TRANSITIONAL			V		S
1606		TURBULENT			V	M	S
1606	07	VARIATION	N		V	M	S
1606	10	WING	N			M	S
1608	10	AERODYNAMIC		T			S
1608	09	BOUNDARY				M	S
1608	09	FLOW	N		V		S
1608	10	FLUCTUATION				M	
1608	09	FREE			V	M	S
1608	09	HOT			V		
1608	09	LAYER	N			M	S
1608	09	MACH					S
1608	10	MASS			V	M	S

1608	09	MEASUREMENT	N				S
1608	10	NOISE	N	T	V	M	S
1608	10	NOZZLE	N			M	S
1608	09	NUMBER	N		V		S
1608	10	SOUND			V	M	
1608	09	STREAM				M	
1608	09	SUPERSONIC		T	V	M	S
1608	10	TUNNEL	N	T	V		
1608	09	TURBULENT			V	M	S
1608	10	WALL	N				S
1608	10	WAVE	N			M	S
1608	10	WIND		T	V		S
1608	09	WIRE			V	M	S
1613	07	AERODYNAMIC					
1613	10	AIR		T			S
1613	09	ANALYTICAL			V		S
1613	10	ATMOSPHERE	N	T	V		S
1613	10	CONTRACTION	N	T		M	
1613	09	DISTANCE	N			M	S
1613	10	DRAG	N	T		M	S
1613	10	ECCENTRICITY	N		V	M	S
1613	10	ELLIPTIC					S
1613	07	FORCE	N			M	S
1613	09	METHOD	N		V		S
1613	06	OBLATE				M	S
1613	10	ORBIT		T	V	M	
1613	10	ORBITAL			V		
1613	10	PERIGEE			V		S
1613	09	PERIOD	N			M	
1613	09	PERTURBATION				M	S
1613	08	ROTATION	N		V		
1613	10	SATELLITE		T		M	S
1613	09	SMALL			V	M	S
1613	10	SPHERICALLY		T	V	M	S
1613	09	STUDY	N		V		S
1613	10	SYMMETRICAL		T	V	M	
1613	07	VECTOR	N			M	S
1613	07	VELOCITY			V		
1614	10	AIR		T			S
1614	09	ANALYTICAL				M	
1614	10	ATMOSPHERE	N	T			
1614	08	CIRCULAR			V	M	S
1614	10	CONTRACTION	N	T	V		S
1614	08	DENSITY	N				S
1614	07	DISTANCE	N		V		
1614	10	DRAG	N	T		M	S
1614	10	ECCENTRICITY	N			M	
1614	10	ELLIPTIC			V	M	S
1614	08	LIFE			V	M	
1614	10	OBLATE		T			S
1614	10	ORBIT		T	V		
1614	08	ORBITAL					

1614	08	PERIGEE					S
1614	07	PERIOD	N			M	S
1614	10	ROTATING			V	M	S
1614	10	SATELLITE	N	T	V	M	S
1614	09	SMALL			V	M	S
1614	09	SOLUTION	N		V	M	S
1615	07	AERODYNAMIC				M	
1615	10	AIR		T		M	S
1615	10	ATMOSPHERE	N			M	S
1615	09	CONTRACTION	N	T	V	M	S
1615	08	DENSITY					S
1615	07	DISTANCE	N		V	M	S
1615	10	DRAG	N	T	V		S
1615	10	ECCENTRICITY	N	T	V	M	S
1615	10	ELLIPTIC			V	M	
1615		FORCE	N			M	
1615	08	GRAVITATIONAL			V	M	S
1615	07	HEIGHT			V	M	S
1615	10	HIGH		T	V	M	S
1615	08	LIFETIME	N		V		S
1615	08	LUNISOLAR			V	M	S
1615	10	ORBIT		T	V		S
1615	08	ORBITAL					
1615	08	OSCILLATION	N		V		
1615	08	PERIGEE	N		V		S
1615	07	PERIOD	N			M	S
1615	07	PERTURBATION	N		V		S
1615	07	PRESSURE	N		V		
1615	08	RADIATION			V	M	S
1615	10	SATELLITE		T	V		S
1615	08	SOLAR					S
1615	10	SPHERICALLY					S
1615	10	SYMMETRICAL			V		
1615	07	TIME				M	S
1615	07	VARIATION	N		V	M	S
1616	10	AIR		T	V		
1616	10	ATMOSPHERE		T		M	S
1616	10	ATMOSPHERIC				M	
1616	10	AXIS	N				S
1616	07	CALCULATION	N		V	M	
1616	09	CHANGE					S
1616	10	DENSITY	N	T	V	M	S
1616	09	DETERMINATION	N	T			
1616	09	DISTANCE	N		V		S
1616	10	DRAG	N				S
1616	10	ELLIPTIC				M	S
1616	09	EXPLORER	N				
1616	10	HEIGHT	N	T	V	M	S
1616	09	OBSERVATION	N	T		M	S
1616	10	ORBIT	N		V		
1616	10	PERIGEE			V	M	S
1616	07	PERIOD	N		V	M	S

1616	09	RATE			V		
1616	10	RESISTANCE			V	M	S
1616	10	SATELLITE		T			S
1616	10	SCALE		T	V		S
1616	09	SEMIMAJOR			V		S
1616	09	SPUTNIK	N			M	S
1616	09	TIME	N				
1616	09	UPPER		T	V		S
1616	09	VANGUARD	N			M	
1617	10	AIR		T	V		
1617	10	APOGEE			V		S
1617	10	ATMOSPHERE	N	T			
1617	10	AXIS				M	S
1617	09	CHANGE	N		V	M	S
1617	10	DENSITY		T	V	M	S
1617	09	DETERMINATION	N	T			
1617	09	DISTANCE				M	S
1617	10	DRAG	N		V	M	S
1617	10	EXPLORER	N				S
1617	09	HEIGHT	N			M	
1617	09	MOTION			V	M	S
1617	10	OBSERVATION	N	T			S
1617	10	ORBIT	N				S
1617	10	PERIGEE	N		V		
1617	10	RELATIVE					S
1617	10	SATELLITE		T			
1617	10	SCALE				M	S
1617	09	SEMIMAJOR				M	
1617	10	SPUTNIK	N		V	M	S
1617	09	UPPER		T		M	S
1617		VARIATION				M	S
1618	10	APOGEE			V	M	S
1618	08	ARTIFICIAL		T	V		S
1618	10	ATMOSPHERIC			V		S
1618	08	AXIS	N		V	M	S
1618	09	BELT	N				S
1618	10	DECAY	N	T			S
1618	10	DRAG	N		V	M	S
1618	09	EARTH			V		S
1618	08	ECCENTRICITY	N			M	S
1618	10	ELLIPTIC			V		S
1618	09	EQUATORIAL					S
1618	09	HEIGHT	N		V		S
1618	08	INCLINATION	N		V	M	S
1618	09	INVESTIGATION	N		V		S
1618	08	LIFETIME	N		V	M	
1618	09	MODEL			V		S
1618	08	MOTION		T		M	
1618	06	NODE			V	M	S
1618	10	OBLATENESS	N				
1618	10	ORBIT	N	T	V		S
1618	10	PERIGEE			V		

1618	07	PREDICTION	N	T	V	M	S
1618	09	RATE					S
1618	06	REGRESSION	N		V	M	
1618	09	ROTATION	N		V	M	S
1618	10	SATELLITE	N	T		M	S
1618	08	SEMIMAJOR				M	S
1618	08	VARIATION			V		
1619	09	AIR			V		S
1619	05	ANGLE					S
1619	10	ATMOSPHERE	N	T			
1619	08	ATMOSPHERIC			V	M	S
1619	08	AXIS	N		V	M	S
1619	10	CONTRACTION	N		V	M	
1619	08	DAYTONIGHT	N		V		S
1619	10	DENSITY	N	T			S
1619	09	DETERMINATION	N		V		S
1619	08	DRAG			V	M	
1619	08	LATITUDE	N			M	S
1619	08	MODE				M	S
1619	10	ORBIT	N	T		M	
1619	08	PERIGEE	N		V	M	S
1619	10	RATE			V		S
1619	08	ROTATION	N		V		S
1619	10	SATELLITE		T	V		S
1619	08	SEASON	N				S
1619	06	SUN			V	M	S
1619	10	UPPER		T	V		S
1619	08	VARIATION			V	M	
1620	06	ABSORPTION			V	M	S
1620		ACCELERATION	N		V		S
1620	10	AIR			V		
1620	08	ALTITUDE	N			M	S
1620	10	ATMOSPHERE	N	T	V		S
1620	10	ATMOSPHERIC			V	M	S
1620	06	CENTIMETRE			V		S
1620	06	CONDUCTION	N			M	S
1620	06	CURVE	N		V	M	S
1620	10	DENSITY	N		V		S
1620	08	DIURNAL				M	S
1620	10	EARTH	N	T	V		
1620		ELECTROMAGNETIC	N		V		S
1620	06	HEAT			V		S
1620	08	INVERSION	N		V		S
1620	08	KILOMETRE			V		
1620	08	LAYER	N		V	M	S
1620	06	LOGARITHMIC				M	S
1620	09	MEASUREMENT	N			M	S
1620	06	RADIATION	N		V		S
1620	10	SATELLITE	N	T			
1620	08	SEASONAL			V	M	S
1620	06	SOLAR			V	M	S

1620	08	TEMPERATURE			V	M	S
1620	06	ULTRAVIOLET			V	M	S
1620	10	UPPER		T			S
1620	08	VARIATION	N		V		S
1621	08	ACTIVITY	N		V	M	S
1621	10	AIR		T			S
1621	10	ALTITUDE	N		V	M	S
1621	10	ATMOSPHERE	N			M	
1621	09	CALCULATION	N				S
1621	08	CURVE	N		V		
1621	08	DAYTIME			V	M	
1621	10	DENSITY	N	T	V	M	S
1621	10	DISCOVER					
1621	10	DIURNAL		T		M	
1621	08	FLUX				M	S
1621	09	KILOMETRE		T		M	S
1621	10	LATITUDE		T	V		S
1621	08	LOGARITHMIC			V	M	S
1621	08	NIGHTTIME			V	M	S
1621	10	ORBIT	N	T			S
1621	06	PERIOD				M	
1621	06	REVOLUTION	N		V		
1621	10	SATELLITE	N	T	V		S
1621	08	SOLAR			V	M	S
1621	08	STANDARD			V	M	S
1621	10	UPPER					S
1621	10	VARIATION	N	T			
1622	06	AIR			V	M	S
1622	08	ATLAS	N			M	
1622	10	ATMOSPHERE	N	T	V		S
1622	07	CHANGE	N	T	V	M	S
1622	06	CONTRACTION	N		V		S
1622	09	DECREASE	N				S
1622	10	DENSITY			V	M	S
1622	05	DISTANCE	N		V		S
1622	06	DRAG	N		V	M	S
1622	10	ECCENTRICITY	N			M	S
1622	08	EXPLORER	N		V		S
1622	09	HEIGHT	N	T	V	M	S
1622	00	MEASUREMENT	N				
1622	08	MIDAS	N		V		
1622	06	OBLATE					S
1622	10	ORBIT	N	T	V	M	S
1622	10	ORBITAL					S
1622	10	PERIGEE			V	M	S
1622	10	PERIOD			V		
1622	10	REVOLUTION				M	S
1622	10	SATELLITE		T	V	M	
1622	10	SCALE		T			
1622	09	SMALL			V		S
1622	08	SPUTNIK	N		V	M	
1622	05	TIME	N				S
1622	10	UPPER		T			S

1622	05	VARIATION					S
1655	07	ANGLE			V	M	S
1655	07	ATTACK	N		V	M	S
1655	08	BLUNTED			V		
1655	10	BLUNTNESS	N	T	V		
1655	09	BODY	N	T		M	
1655	09	BOUNDARY		T	V		
1655	07	COEFFICIENT	N		V	M	S
1655	07	COMBINED			V	M	S
1655	08	CONE	N		V	M	S
1655	10	DISPLACEMENT	N	T		M	S
1655	09	DISTRIBUTION	N	T	V		
1655	10	EDGE		T	V		
1655	07	EFFECT	N	T	V		S
1655	08	FLAT			V	M	
1655	09	FLOW	N		V	M	S
1655	07	FORCE			V	M	S
1655	10	FRICTION	N	T	V	M	S
1655	09	HEAT		T	V		S
1655	09	HYPERSONIC		T	V		
1655	09	LAYER		T		M	
1655	10	LEADING		T	V	M	
1655	07	NORMAL			V		
1655	08	NOSED				M	
1655	08	PLATE	N		V	M	S
1655	09	PRESSURE		T			
1655	08	ROD	N		V	M	
1655	08	SHARP			V		S
1655	10	SKIN		T	V		
1655	09	SURFACE			V		S
1655	08	SWEEP	N		V	M	S
1655	09	THREEDIMENSIONAL			V		S
1655	09	TRANSFER	N	T	V	M	S
1655	09	TWODIMENSIONAL				M	S
1655	08	VISCOUS			V	M	S
1656	07	APPROXIMATE			V	M	S
1656	06	BLUNT			V	M	S
1656	00	CALCULATION	N		V	M	S
1656	06	CONDITION	N		V	M	
1656	08	CONICAL			V	M	S
1656	07	CONSTANT	N		V		S
1656	10	DEVIATION	N		V		S
1656	10	DISSOCIATING					
1656	10	DISSOCIATION	N	T	V	M	S
1656	06	DISTANCE	N		V		S
1656	08	EFFECT	N		V	M	S
1656	09	EQUATION	N		V	M	S
1656	10	EQUILIBRIUM	N	T		M	S
1656	06	FINITE			V		S
1656	09	FLOW	N		V	M	S
1656	08	FRACTION	N		V	M	S
1656	08	FREEZING			V		S

1656	10	GAS	N		V		S
1656	07	GRATE				M	S
1656	09	HYPERSONIC		T			S
1656	10	IDEAL			V		S
1656	05	MODE	N		V		S
1656	06	MOLECULAR			V	M	S
1656	08	MOTION	N		V	M	S
1656	08	NEARLY			V		S
1656	10	NOZZLE	N	T			S
1656	07	NUMERICAL				M	S
1656	06	DNEDIMENSIONAL					S
1656	06	PRESSURE	N		V		
1656	06	QUASI			V	M	S
1656	07	RATE			V		S
1656	06	RECOMBINATION	N		V		S
1656	06	REDUCTED			V		S
1656	08	RELAXATION			V		S
1656	06	SECTION	N		V		S
1656	06	SHOCK			V	M	S
1656	07	SOLUTION	N		V	M	
1656	06	STAGNATION			V	M	S
1656	06	STANDOFF			V	M	S
1656	06	TEMPERATURE	N		V	M	S
1656	06	TUBE	N		V	M	S
1656	06	TUNNEL	N		V		S
1656	06	UPSTREAM			V		S
1656	06	WAVE	N		V	M	S
1656	06	WIND			V		S
1656	06	WORKING			V		S
1666	09	ANALYSIS	N		V	M	S
1666	08	BEHIND			V		
1666	10	BLUNT		T	V	M	
1666	10	BODY	N	T	V	M	S
1666	08	BOUNDARY			V		
1666	08	CURVATURE	N		V		S
1666	08	DATA	N				S
1666	09	DETERMINATION			V	M	S
1666	05	DIFFERENTIAL			V	M	S
1666	06	ENERGY			V	M	S
1666	06	ENTROPY			V	M	S
1666	05	EQUATION	N		V	M	S
1666	08	EXPERIMENTAL			V		
1666	08	FIELD			V		
1666	08	FLOW	N		V	M	S
1666	06	GRADIENT	N			M	
1666	09	HEAT		T	V	M	S
1666	09	HYPERSONIC		T	V		S
1666		LOW		T	V	M	S
1666	06	MOMENTUM			V		S
1666	08	NOSE			V	M	
1666	09	NUMBER	N	T	V		S
1666	06	POINT	N		V		
1666	08	REGION	N		V		S
1666	09	REYNOLDS		T	V		S
1666	08	SHEAR			V	M	S
1666	08	SHOCK	N		V	M	S

			N	T	V	M	S
1666	07	SPEED	N	T	V		S
1666	06	SPHERICAL			V		
1666	06	STAGNATION			V		S
1666		TRANSFER	N	T	V	M	S
1666	06	VORTICITY	N		V	M	S
1666	08	WALL	N		V	M	S
1667	10	AXISYMMETRIC			V		S
1667	07	BEHIND			V		S
1667	09	BOUNDARY					
1667	08	CONDUCTION	N		V	M	S
1667	08	CONTINUUM			V		S
1667	06	COOLING	N		V		
1667	08	DISTANCE	N		V		S
1667	05	DOMAIN	N		V	M	S
1667	08	EFFECT	N		V		
1667	06	ENTHALPY			V	M	S
1667	09	FLOW	N		V	M	
1667	06	FREE			V		
1667	06	FRICTION	N		V		S
1667	06	FUNCTION	N		V	M	S
1667	08	HEAT				M	S
1667	08	HUGONIOT			V		S
1667	09	HYPERSONIC		T	V		S
1667	05	INCIPIENT			V		
1667	08	INTERACTION			V	M	S
1667	10	LAYER	N	T	V		S
1667	06	LIMIT	N		V		S
1667	10	LOW		T	V	M	S
1667	05	MERGED			V	M	S
1667	06	MOLECULE			V		
1667	09	NUMBER	N	T	V	M	S
1667	07	ONE	N		V	M	S
1667	08	PROCESS	N		V	M	S
1667	06	PROFILE	N		V	M	
1667	08	RANKINE			V	M	S
1667	07	RATE	N		V		S
1667	07	REGIME	N			M	S
1667	10	REGION	N	T			S
1667	08	RELATION	N		V	M	S
1667	10	REYNOLDS		T	V	M	S
1667	10	SHOCK	N	T	V		S
1667	06	SKIN			V	M	S
1667	10	STAGNATION		T		M	S
1667	08	STANDOFF			V		S
1667	06	STRONG			V	M	S
1667	06	SURFACE			V		S
1667	09	THEORY	N	T	V		S
1667	07	THIN			V	M	S
1667	08	TRANSFER	N		V	M	S
1667	05	TRANSITION			V	M	S
1667	08	TRANSPORT				M	S
1667	07	TWO	N		V		S
1667	06	VELOCITY			V	M	S
1667	08	VISCOUS					S
1667	08	VORTICITY			V	M	
1667	06	ZONE	N		V	M	S

1670	09	ANALYTICAL			V	M	S
1670	10	BLUNT		T	V		
1670	10	BODY	N	T	V	M	S
1670	09	DENSITY			V		S
1670	09	HYPERSONIC		T		M	
1670	09	LOW		T	V	M	
1670	09	NUMBER	N	T	V	M	
1670	10	POINT			V		
1670	09	RESULT	N		V		S
1670	10	REYNOLDS		T	V	M	S
1670	10	STAGNATION			V		S
1670	09	TRANSFER	N	T			S
1670	08	VAPOUR				M	
1670	08	VORTICITY	N		V	M	S
1671	08	AERODYNAMIC			V	M	S
1671	09	BOUNDARY		T	V		S
1671	08	CENTRE			V		S
1671	07	CHARACTERISTIC	N		V		S
1671	05	COEFFICIENT	N				S
1671	06	DISPLACEMENT				M	
1671	07	DISTRIBUTION	N		V	M	S
1671	08	DRAG	N		V		S
1671	07	EFFECT	N		V	M	S
1671	08	FORCE	N		V		S
1671	06	FORM			V	M	S
1671	08	GROWTH	N		V		S
1671	08	HEAD			V	M	S
1671	09	LAYER	N	T	V		
1671	08	LIFT	N		V		S
1671	09	MEASUREMENT	N	T	V	M	S
1671	06	MOMENT	N		V	M	
1671	06	MOMENTUM			V	M	S
1671	05	NORMAL			V	M	S
1671	05	PARAMETER	N		V	M	S
1671	10	PERCENT			V	M	S
1671	06	PITCHING			V		S
1671	07	PREDICTION				M	S
1671	09	PRESSURE		T	V		S
1671	10	SECTION	N		V	M	S
1671	08	STATIC			V		
1671	09	SUBSONIC			V	M	S
1671	06	TANGENTIAL			V		S
1671	06	THICKNESS	N		V		S
1671	07	TOTAL			V		S
1671	08	TRANSITION	N		V	M	S
1671	09	TRAVERSE	N			M	S
1671	09	TUNNEL	N		V		S
1671	07	TURBULENT			V	M	S
1671	10	TWODIMENSIONS			V		S
1671	08	VELOCITY			V		
1671	08	V' COSITY			V	M	S
1671	09	WIND			V	M	S

1671	10	WING	N	T	V	M	S
1672	05	AEROFOIL	N		V	M	S
1672	06	AIR	N		V	M	S
1672	05	AIRCRAFT	N		V		S
1672	05	ANGLE			V	M	S
1672	06	ASPECT			V	M	S
1672	08	BLOCKAGE	N		V	M	S
1672	06	BODY			V	M	S
1672	07	BOUND			V	M	S
1672	10	BOUNDARY			V	M	S
1672	05	BUMP	N		V		S
1672	05	CALCULATION	N		V		S
1672	06	CAMBER			V	M	S
1672		CHOKING	N		V		SA
1672	08	CIRCULAR			V	M	S
1672	09	CLOSED			V		S
1672	05	COEFFICIENT	N		V		S
1672	05	COMPLETE			V	M	S
1672	06	CONDENSATION			V	M	S
1672	09	CONDITION	N		V	M	S
1672	10	CONSTRAINT	N		V		S
1672	06	CONTROL	N		V	M	S
1672	08	CORRECTION	N				S
1672	06	CURVATURE	N		V		S
1672	06	DISTURBANCE	N		V		S
1672	06	DOWNSTREAM			V	M	S
1672	07	DRAG				M	S
1672	06	DRIERS	N		V	M	S
1672	06	DRY			V	M	S
1672	10	EFFECT	N	T	V	M	S
1672	06	FINITE			V		
1672	07	FLOW	N				S
1672	06	FREESTREAM			V		S
1672	06	GAS	N		V	M	S
1672	06	GRADIENT	N		V		S
1672	05	GROUND			V		S
1672	07	HIGH			V		S
1672	06	HUMIDITY	N		V	M	S
1672	05	INCIDENCE			V		S
1672	07	INDUCED			V	M	S
1672	10	INTERFERENCE	N	T	V	M	S
1672	08	JET			V	M	S
1672	06	LAYER			V	M	S
1672	08	LIFT				M	
1672	06	LIFTING			V		S
1672	05	LINE			V	M	S
1672	06	LIQUEFACTION			V		S
1672	05	LOCKHEED			V		S
1672	07	MACH			V	M	S
1672	06	MASS			V		S
1672	05	METHOD	N		V	M	S
1672	08	MODEL	N		V		S
1672	08	MOISTURE			V	M	S
1672	05	NEAR			V		
1672	06	NONPERFECT			V	M	S
1672	06	NUMBER	N		V	M	S

1672	08	OCTAGONAL				M	S
1672	08	OPEN			V		S
1672	06	POINT	N		V	M	S
1672	06	PRESSURE	N		V		S
1672	05	PROFILE			V	M	S
1672	06	PROPELLER	N			M	S
1672	05	RATIO			V	M	S
1672	08	RECTANGULAR			V		S
1672	06	RELAXATION			V	M	S
1672	06	REVOLUTION	N		V	M	S
1672	06	RIGID			V	M	S
1672	06	SATURATION			V		S
1672	09	SECTION	N		V	M	S
1672	06	SETTING	N		V		S
1672	08	SOLID			V		S
1672	05	SOLUTION	N		V	M	S
1672	06	SPAN			V	M	S
1672	08	SPANNING			V		S
1672	07	SPEED	N		V	M	S
1672	06	STATIC			V	M	S
1672	05	STRAIGHT			V		S
1672	06	STREAMLINE			V	M	S
1672	06	SUBSONIC			V	M	S
1672	07	SUPERSONIC			V		S
1672	05	SYSTEM			V		S
1672	06	TAIL			V	M	S
1672	05	TAILPLANE	N		V	M	S
1672	06	TEMPERATURE	N				S
1672	07	TEST	N		V	M	S
1672	07	TESTING	N		V		S
1672	06	THREEDIMENSIONAL			V	M	S
1672	09	THROAT			V		S
1672	06	TIME			V	M	S
1672	10	TUNNEL	N	T	V		S
1672	06	TWODIMENSIONAL			V	M	S
1672	06	UNITY	N		V	M	S
1672	07	VELOCITY	N		V		S
1672	06	VORTEX	N		V		S
1672	08	WAKE			V		S
1672	10	WALL	N		V	M	S
1672	10	WIND		T	V	M	S
1672	08	WING	N		V		S
1672	09	WORKING			V		S
1672	08	ZERO			V	M	
1675	06	AERODYNAMIC					S
1675	07	BOUNDARY			V		S
1675	06	CENTRE	N		V	M	S
1675	09	CHORDWISE			V	M	
1675	10	CURVED		T	V		S
1675	09	DEGREE		T	V	M	
1675	08	DISPLACEMENT	N			M	S
1675	09	DISTRIBUTION	N	T	V	M	S
1675	08	EDGE			V		S
1675	07	EFFECT	N		V	M	
1675	09	FLOW	N	T		M	S
1675	09	INCIDENCE	N		V	S

1675	08	ISOBAR	N		V	M	S
1675	07	LAYER			V		S
1675	08	LEADING			V		
1675	08	LIFT	N		V	M	S
1675	07	LOCAL			V		S
1675	08	LOCATION			V		S
1675	08	LONGITUDINAL				M	S
1675	07	MAIN			V		S
1675	09	MEASUREMENT	N		V	M	
1675	08	OIL			V	M	S
1675	07	ONSET	N				S
1675	07	PART				M	S
1675	08	PATTERN	N		V		S
1675	09	PERCENT		T	V	M	S
1675	10	PLANFORM	N		V	M	S
1675	09	PRESSURE	N	T	V	M	
1675	10	RAE			V		S
1675	10	RAE			V	M	S
1675	07	REARWARD			V	M	
1675	08	ROUGHNESS	N			M	S
1675	08	SCALE			V		S
1675	07	SECONDARY			V	M	S
1675	09	SECTION	N		V		
1675	09	SEPARATION	N		V		S
1675	07	SPAN			V	M	S
1675	06	SPANWISE			V	M	
1675	08	STABILITY	N		V	M	S
1675		STALL	N		V	M	
1675	08	STALLING	N		V	M	S
1675	10	STREAMWISE			V	M	S
1675	07	STRENGTH	N		V	M	S
1675	09	SUBSONIC			V		
1675	09	TUNNEL					S
1675	07	TURBULENT					S
1675	08	VORTEX	N		V	M	S
1675	09	WIND			V	M	S
1675	08	SUCTION	N		V	M	S
1675	09	SURFACE		T	V		S
1675	10	SWEEPBACK		T	V		S
1675	10	THICK		T	V	M	S
1675	10	TIP		T	V		S
1675	08	TRAILING			V		S
1675	08	TRANSITION	N		V	M	S
1675	10	WING		T	V	M	S
1676	07	ASPECT		T	V		SA
1676	09	CALCULATION	N		V	M	SA
1676	07	CENTRE				M	SA
1676	10	CHORDWISE		T	V	M	SA
1676	09	COMPRESSIBLE			V		SA
1676	08	DOWNWASH	N		V	M	A
1676	08	DRAG	N		V		SA
1676	09	FLOW	N		V	M	SA
1676	07	INDUCED			V	M	SA
1676	07	INFINITE			V	M	A
1676	08	LIFT	N		V	M	A
1676	10	LIFTING				M	SA

1676	10	LOADING	N	T		M		A
1676	07	NONLINEAR			V	M	S	A
1676	07	RATIO		T	V	M		A
1676	05	SECTIONAL			V		S	A
1676	05	SLOPE				M	S	A
1676	10	SPANWISE		T	V		S	A
1676	09	STRAIGHT		T	V			A
1676	09	SUBSONIC		T	V	M	S	A
1676	10	SURFACE			V		S	A
1676	10	SWEPT		T	V		S	A
1676	09	THEORY	N		V			A
1676	07	THICK			V	M		A
1676	09	THIN			V	M	S	A
1676	08	TRAILING				M	S	A
1676	10	UNCAMBERED				M	S	A
1676	07	UNIFORM				M	S	A
1676	08	VORTEX	N			M	S	A
1676	10	WING	N	T	V	M	S	A
1677	05	AERODYNAMIC			V	M		A
1677	06	ASPECT			V	M	S	A
1677	10	CALCULATING	N	T		M		A
1677	07	CALCULATION	N		V		S	A
1677	06	CENTRAL			V		S	A
1677	08	CHORDWISE	N		V		S	A
1677	06	CIRCULAR			V			A
1677	06	COMPRESSIBILITY	N		V	M	S	A
1677	09	COMPUTER	N				S	A
1677	06	DELTA			V			A
1677	10	DISTRIBUTION	N	T	V	M	S	A
1677	08	DOWNWASH			V	M	S	A
1677	06	DRAG	N		V	M	S	A
1677	08	EQUATION	N		V	M	S	A
1677	07	EXPERIMENT	N			M	S	A
1677	06	FLAP	N		V			A
1677	06	FORCE				M		A
1677	06	INDUCED			V		S	A
1677	06	INFINITE					S	A
1677	08	INTEGRAL			V	M	S	A
1677	10	LIFT		T	V		S	A
1677	10	LIFTING		T	V			A
1677	08	LINEAR			V		S	A
1677	10	LOAD			V		S	A
1677	09	METHOD		T			S	A
1677	06	MIDDLE			V		S	A
1677	06	MOMENT	N		V	M		A
1677	06	PIVOTAL				M	S	A
1677	06	PLANFORM			V	M	S	A
1677	06	POINT	N		V	M	S	A
1677	08	PRACTICAL			V	M	S	A
1677	06	RATIO				M		A
1677	06	ROUNDINGOFF			V	M	S	A

1677	06	RULE	N		V	M	SA
1677	06	SECTION	N		V	M	SA
1677	07	SOLUTION	N		V		SA
1677	08	SPANWISE	N		V	M	SA
1677	10	SUBSONIC		T	V		SA
1677	10	SURFACE	N	T	V	M	SA
1677	06	SWEPT			V		SA
1677	08	TABLE			V		SA
1677	09	THEORY	N	T	V	M	SA
1677	10	WING	N	T	V	M	SA
1680	09	ANALYSIS	N		V	M	SA
1680	09	COMPRESSIBLE				M	SA
1680	08	DEFLECTED			V	M	SA
1680	07	DIFFERENTIALLY			V		SA
1680	07	DISTRIBUTION	N		V	M	SA
1680	10	EDGE	N		V	M	A
1680	09	EQUATION	N		V		SA
1680	10	FIELD	NN	T		M	SA
1680	09	FLOW	N	T	V	M	SA
1680	09	INTEGRAL			V	M	A
1680	10	LEADING			V		SA
1680	08	LIFTING			V	M	SA
1680	09	LINEARIZED			V	M	SA
1680	08	LOADING					SA
1680	08	PARABOLIC				M	SA
1680	00	PITCHING			V		SA
1680	07	PRESSURE			V	M	SA
1680	10	QUASICONICAL			V	M	SA
1680	07	RELATION			V	M	SA
1680	08	ROLLING			V		SA
1680	08	SHAPE	N		V	M	SA
1680	09	SUBSONIC			V		SA
1680	09	SUPERSONIC		T	V	M	SA
1680	08	SURFACE			V	M	SA
1680	07	SYMMETRICAL			V	M	SA
1680	08	THICKNESS				M	A
1680	10	TRIANGULAR			V	M	SA
1680	08	TWIST	N		V		A
1680	06	UPWASH					SA
1680	10	VELOCITY				M	SA
1680	10	WING	N	T	V	M	SA
1680	08	YAWED			V	M	SA
1681	06	ABEL					SA
1681	05	AEROFOIL			V	M	A
1681	07	ANGLE			V	M	SA
1681	07	ATTACK	N		V	M	SA
1681	07	BODY	N		V	M	SA
1681	08	CAMBER	N		V		SA
1681	07	COMBINED					SA
1681	08	CONICAL			V		SA
1681	07	CONVEX			V	M	SA
1681	08	DEFLECTED			V	M	SA
1681	07	DIFFERENTIALLY			V	M	SA
1681	08	DISCONTINUITY			V		SA
1681	09	DISTRIBUTION	N			M	SA

1681	10	DOUBLET			V		SA
1681	07	DRAG			V	M	A
1681	08	EDGE	N		V		SA
1681	07	EDGED			V		SA
1681	07	ELEMENT	N		V		SA
1681	09	ELEMENTARY			V		SA
1681	10	EQUATION	N	T	V	M	SA
1681	07	FIELD	N		V		SA
1681	06	FINITE			V	M	SA
1681	07	FLAT			V	M	SA
1681	09	FLOW	N		V	M	SA
1681	10	HORSESHOE			V	M	SA
1681	09	INDUCED			V		SA
1681	10	INTEGRAL		T			SA
1681	08	INVERSION	N		V		SA
1681	08	LEADING					SA
1681	08	LIFTING			V	M	SA
1681	09	LINEARIZED		T	V	M	SA
1681	08	LOAD			V	M	SA
1681	08	LOADING	N		V	M	SA
1681	06	MACH			V	M	SA
1681	06	MULTIPLE			V		SA
1681	08	NONLIFTING			V	M	SA
1681	06	PART	N		V	M	SA
1681	10	PERTURBATION			V	M	SA
1681	07	PLANE			V	M	SA
1681	07	PLATE	N		V	M	SA
1681	09	POTENTIAL	N		V		SA
1681	09	PRESSURE	N		V	M	SA
1681	08	QUASICONICAL			V	M	SA
1681	07	RECTANGULAR			V		SA
1681	06	REFLECTION			V	M	SA
1681	07	REVERSIBILITY				M	SA
1681	07	SECTION	N		V		SA
1681	07	SHAPE	N		V	M	SA
1681	08	SHARP			V		SA
1681	05	SINGULAR			V	M	SA
1681	07	SLENDER			V		SA
1681	10	SOURCE			V	M	SA
1681	09	SUBSONIC			V		SA
1681	09	SUPERSONIC			V	M	SA
1681	08	SURFACE	N				SA
1681	06	SWEPTFORWARD				M	SA
1681	07	SYMMETRICAL			V		A
1681	07	THEOREM	N		V	M	SA
1681	09	THEORY	N	T	V		SA
1681	08	THICKNESS	N		V	M	A
1681	06	TIP	N		V	M	SA
1681	08	TRIANGULAR			V	M	SA
1681	08	TWIST	N		V	M	SA
1681	07	UPPER			V	M	A
1681	10	VELOCITY	N		V		SA
1681	09	VERTICAL				M	SA
1681	10	VORTEX			V	M	SA

1681	06	WAVE	N		V	M	SA
1681	10	WING	N	T	V	M	SA
1682	09	ANTISYMMETRIC				M	SA
1682	09	CALCULATION	N		V		SA
1682	10	CAMBERED		T	V	M	SA
1682	10	CONICAL				M	SA
1682	09	DISTRIBUTION	N		V	M	SA
1682	10	DOWNWASH			V		A
1682	10	EDGE	N		V	M	SA
1682	09	EQUATION	N		V		SA
1682	09	FLOW	N	T	V	M	SA
1682	06	FLUTTER	N			M	SA
1682	09	GENERALIZED			V	M	SA
1682	09	INTEGRAL			V		A
1682	10	LEADING			V	M	SA
1682	10	LIFT		T		M	A
1682	09	POTENTIAL	N				SA
1682	09	SUBSONIC			V		SA
1682	09	SUPERSONIC		T	V	M	SA
1682	09	SYMMETRIC				M	SA
1682	09	THEORY	N		V	M	SA
1682	06	TRANSONIC			V		A
1682	10	TWISTED		T			SA
1682	09	VELOCITY			V	M	A
1682	09	WING	N	T	V		A
1683	10	ATTACHMENT	N	T		M	SA
1683	07	CALCULATION	N		V	M	SA
1683	10	CAMBER	N	T	V	M	SA
1683	10	CONICAL		T	V		A
1683	10	DELTA		T	V		SA
1683	09	DEPENDENT		T	V		A
1683	08	DISTRIBUTION	N		V		A
1683	10	DRAG	N	T		M	A
1683	10	EDGE	N	T	V	M	A
1683	06	FLAP	N			M	SA
1683	08	FLOW		T	V	M	A
1683	06	HINGED			V	M	A
1683	10	LEADING		T		M	SA
1683	10	LIFT		T			SA
1683	07	LINE	N		V		A
1683	08	LINEARIZED				M	SA
1683	08	LOAD			V		SA
1683	06	MACH			V		SA
1683	05	NEARLY			V	M	SA
1683	05	NUMBER	N			M	SA
1683	10	SEPARATION	N		V	M	A
1683	06	SHAPE	N		V		SA
1683	08	SLENDER			V		A
1683	09	SONIC		T	V	M	SA
1683	09	SPEED	N	T	V	M	SA
1683	09	SUBSONIC			V		SA

1683	06	SUCTION	N		V	M	A
1683	09	SUPERSONIC		T	V	M	A
1683	09	THEORY	N				SA
1683	09	THIN					A
1683	06	UPWASH				M	A
1683	08	VANISHING			V		SA
1683	10	WING	N	T	V		SA
1684	06	AXIS	N			M	SA
1684	09	COMPLETE			V	M	SA
1684	10	ELLIPTIC		T	V	M	SA
1684	06	GRAVITY			V	M	SA
1684	06	GYROSCOPIC			V		SA
1684	05	INFLUENCE					SA
1684	10	INTEGRAL	N	T	V		SA
1684	06	MOTION	N		V	M	SA
1684	06	PARTICLE	N		V	M	SA
1684	06	PENDULUM	N		V	M	A
1684	06	REACTION	N		V	M	A
1684	06	REVOLUTION			V	M	A
1684	06	SMOOTH			V		SA
1684	05	SOLUTION	N		V		SA
1684	06	SPHERICAL			V		SA
1684	06	SURFACE			V		SA
1684	09	TABLE	N	T	V		SA
1684	06	VERTICAL			V	M	SA
1687	09	AERODYNAMIC			V	M	A
1687	10	AEROFOIL	N	T	V	M	SA
1687	07	CENTRE	N		V		SA
1687	08	CHORD					SA
1687	07	COEFFICIENT	N		V	M	SA
1687	08	CONVEX			V	M	SA
1687	08	DAMPING			V		SA
1687	09	DISTRIBUTION	N				SA
1687	09	FLOW	N		V	M	SA
1687	09	FORMULA	N		V		SA
1687	10	OSCILLATION	N		V	M	SA
1687	08	PISTON			V		SA
1687	10	PITCHING			V	M	SA
1687	09	PRESSURE				M	SA
1687	07	RATIO	N		V		SA
1687	09	SUPERSONIC				M	SA
1687	09	SYMMETRICAL			V	M	SA
1687	07	THEORY	N		V	M	SA
1687	08	THICKNESS			V		SA
1687	10	TWODIMENSIONAL			V		SA
1688	09	AERODYNAMIC		T		M	
1688	10	ANGLE		T		M	S
1688	10	ATTACK	N	T			S
1688	05	BEHIND			V	M	S

			N	T	V	M	S
1688	08	BLUNTNESS	N			M	
1688	10	BODY	N	T	V		S
1688	10	CIRCULAR			V	M	S
1688	09	CLOSED			V	M	S
1688	09	COEFFICIENT	N	T			S
1688	10	CONE	N			M	S
1688	05	CONTRIBUTION	N		V	M	S
1688	08	CROSS			V	M	S
1688	07	DATA	N	T		M	S
1688	10	DERIVATIVE	N			M	S
1688	10	DRAG			V		S
1688	06	EDGE			V		S
1688	10	ELLIPTIC			V		S
1688	07	EXPERIMENTAL		T	V	M	S
1688	09	EXPRESSION	N	T	V	M	S
1688	09	FLOW	N		V	M	S
1688	10	FORCE	N		V	M	S
1688	06	FOREBODY			V	M	
1688	09	FORM			V	M	
1688	10	HYPERSONIC		T			
1688	06	INTERFERENCE	N				S
1688	06	LEADING			V	M	
1688	06	LEEWARD			V	M	S
1688	10	LIFT			V	M	S
1688	10	LONGITUDINAL					
1688	10	MOMENT				M	S
1688	10	NEWTONIAN		T	V	M	S
1688	05	NORMAL			V		S
1688	08	NOSE				M	S
1688	10	PITCHING			V		S
1688	08	PREDICTION	N				S
1688	05	PRESSURE			V	M	S
1688	05	REDUCTION	N		V		S
1688	10	REENTRY			V		S
1688	10	REVOLUTION				M	S
1688	08	SECTION	N		V	M	S
1688	10	SEGMENT	N				S
1688	06	SHOCK	N		V	M	S
1688	10	SIDESLIP	N	T		M	S
1688	08	SLOPE	N				S
1688	10	SPHERICAL			V		S
1688	10	STABILITY					
1688	06	STAGNATION			V		
1688	10	STATIC				M	S
1688	08	SURFACE				M	S
1688	09	TABULATION	N				S
1688	10	VEHICLE	N				
1688	06	VISCOUS			V	M	
1691	10	AIR	N	T	V	M	S
1691	10	BURNED		T	V		
1691	09	CALCULATION	N	T	V	M	S
1691	10	COMBUSTION		T	V	M	S
1691	10	COMPOSITION	N		V		S
1691	09	COMPOUND					S
1691	08	CONDUCTIVITY	N				S
1691	07	CONSTANT	N				S

1691	08	DENSITY	N		V	M	S
1691	10	DISSOCIATED			V	M	S
1691	08	ENTHALPY	N			M	S
1691	08	ENTROPY	N				
1691	10	EQUILIBRIUM			V		
1691	08	EQUIVALENCE			V	M	S
1691	10	ETHYLENE	N	T		M	S
1691	07	EXPONENT	N				
1691	08	FLAME			V	M	S
1691	09	FLOW		T	V	M	
1691	10	FUEL	N	T	V	M	S
1691	10	GAS	N				
1691	07	HEAT	N		V	M	S
1691	10	HYDROCARBON		T	V		S
1691	08	ISENTROPIC			V	M	
1691	10	METHANE	N	T		M	
1691	09	MIXED			V		S
1691	10	NOZZLE					S
1691	07	NUMBER	N				
1691	09	ORDINATE	N		V		S
1691	08	PRANDTL			V		S
1691	07	PRESSURE	N		V	M	
1691	09	PRODUCT		T	V		
1691	09	PROPERTY	N	T	V		
1691	07	RATIO	N				S
1691	07	SPECIFIC			V	M	S
1691	10	SUPERSONIC			V		S
1691	07	TEMPERATURE	N			M	S
1691	07	THERMAL			V		S
1691	09	THERMODYNAMIC		T	V	M	
1691	10	TRANSPORT		T	V		S
1691	08	VISCOSITY	N			M	S
1692	07	CENTRE				M	S
1692	10	CHOKED				M	S
1692	10	CONVERGENT			V	M	S
1682	10	DELTA			V	M	SA
1692	07	DISTRIBUTION	N		V	M	S
1692	09	DOWNSTREAM		T	V	M	
1692	06	EXHAUST			V		
1692	10	EXIT	N	T	V	M	S
1692	07	EXTERNAL			V	M	S
1692	10	FLAT		T	V		S
1692	09	FLOW			V	M	S
1692	08	GROSS			V	M	S
1692	06	HELIUM			V	M	
1692	06	HOT			V		S
1692	08	INCREMENTAL			V		S
1692	08	INTERACTION				M	S

1692	10	JET	N	T			
1692	08	LIFT					S
1692	07	LOCATION			V		
1692	09	MACH	N	T			S
1692	10	NACELLE		T	V	M	S
1692	10	NOZZLE	N				
1692	09	PRESSURE	N		V	M	
1692	10	PROPULSIVE			V	M	S
1692	07	RATIO	N		V		S
1692	07	RELATION			V	M	S
1692	08	SHOCK			V	M	S
1692	09	SIMULATED		T	V	M	S
1692	05	SIMULATION	N		V		S
1692	09	STATIC			V	M	S
1692	09	SUPERSONIC			V	M	S
1692	09	SURFACE	N	T	V		S
1692	09	SURVEY	N		V	M	S
1692	07	TEST	N			M	S
1692	08	THRUST	N			M	
1692	10	TURBOJET		T	V	M	S
1692	08	WAKE	N		V		S
1692	08	WAVE				M	S
1692	10	WING			V	M	
1693	10	ANGLE					
1693	10	ATTACK	N			M	S
1693	08	BLOWDOWN			V		S
1693	10	CHOKED			V	M	
1693	07	COEFFICIENT	N			M	S
1693	10	CONVERGENT			V	M	S
1693	07	DISTRIBUTION	N		V		S
1693	10	DIVERGENT			V	M	S
1693	10	DOWNSTREAM		T	V	M	S
1693	08	EXHAUST	N		V	M	S
1693	10	EXIT		T		M	S
1693	10	FLAT		T	V		S
1693	09	FLOW			V		
1693	08	FORCE			V	M	S
1693	06	HELIUM			V	M	S
1693	06	HOT			V		
1693	08	INCREMENT					S
1693	08	INDUCED			V	M	S
1693	10	JET	N	T	V		S
1693	08	LIFT	N		V		S
1693	07	LOCATION	N				
1693	09	MACH	N	T		M	S
1693	10	NACELLE		T	V	M	
1693	07	NORMAL					S
1693	10	NOZZLE	N		V	M	S
1693	09	PRESSURE			V	M	S
1693	10	PROPULSIVE			V	M	S
1693	07	RATIO	N			M	
1693	08	SHOCK			V	M	S
1693	09	SIMULATED		T	V		S
1693	06	SIMULATION	N			M	S
1693	06	SONIC			V		S
1693	09	STATIC				M	S

1693	09	SUPERSONIC			V	M	S
1693	09	SURFACE	N	T		M	S
1693	09	SURVEY	N		V	M	
1693	07	TEST	N			M	S
1693	07	TOTAL			V	M	S
1693	07	TUNNEL			V	M	S
1693	10	TURBOJET		T	V	M	S
1693	08	WAVE			V	M	S
1693	10	WING				M	
1693	09	ZERO			V		S
1694	09	ANGLE	N		V	M	S
1694	06	APEX			V	M	
1694	09	ATTACK	N		V	M	S
1694	10	CHOKED				M	S
1694	05	COEFFICIENT	N			M	S
1694	10	CONVERGENT				M	S
1694	09	DISTRIBUTION	N	T	V	M	S
1694	10	DIVERGENT				M	S
1694	08	EXHAUST		T	V	M	S
1694	10	EXHAUSTING					
1694	08	EXIT			V	M	
1694	10	FLAT		T		M	S
1694	09	FLOW			V	M	S
1694	08	FORCE	N			M	
1694	08	INCREMENTAL					S
1694	08	INDUCED		T	V	M	S
1694	10	JET	N	T	V		S
1694	08	LIFT	N		V		S
1694	07	LOCATION	N		V	M	
1694	09	MACH	N	T	V	M	S
1694	08	NACELLE			V		S
1694	07	NORMAL				M	S
1694	10	NOZZLE	N		V		
1694	10	PLATE		T	V	M	S
1694	09	PRESSURE		T	V		S
1694	10	PROPULSIVE			V		S
1694	07	RATIO	N			M	S
1694	10	SHOCK				M	
1694	10	SONIC		T	V	M	S
1694	09	SUPERSONIC		T	V	M	S
1694	09	SURFACE	N				S
1694	09	TEST	N		V	M	S
1694	06	THRUST			V	M	S
1694	07	TOTAL			V		
1694	08	TURBOJET			V		
1694	10	WAVE					
1694	10	WING			V		S
1694	09	ZERO			V	M	S
1695	08	AIR	N		V	M	S
1695	09	ANGLE			V		S
1695	09	ATTACK	N		V	M	S
1695	09	BLOWDOWN				M	S
1695	08	BURNED					S

1695	08	CARBON			V	M	S
1695	08	COLD			V	M	S
1695	07	COMPOSED			V	M	S
1695	08	DENSITY	N		V	M	S
1695	08	DIOXIDE	N		V	M	S
1695	09	DISTRIBUTION	N		V	M	S
1695	08	EXHAUST			V	M	S
1695	10	EXHAUSTING				M	S
1695	08	EXIT			V		S
1695	10	FLAT				M	S
1695	09	FLOW			V	M	S
1695	08	GAS			V	M	S
1695	08	HEAT	N			M	S
1695	08	HELIUM			V	M	S
1695	08	HOT		T	V	M	S
1695	08	HYDROGEN					S
1695	10	INTERFERENCE	N		V	M	S
1695	10	JET	N	T	V		S
1695	09	MACH	N	T		M	S
1695	08	MIXTURE			V		
1695	10	NACELLE	N		V	M	S
1695	09	PRESSURE			V		S
1695	10	PROPULSIVE			V		S
1695	00	RATIO	N		V		
1695	10	SHOCK			V	M	
1695	09	SIMULATED			V		S
1695	10	SONIC				M	S
1695	08	SPECIFIC					S
1695	07	STATIC			V		S
1695	09	SUPERSONIC				M	S
1695	10	SURFACE		T		M	S
1695	07	SURVEY	N		V		
1695	09	TEST	N		V	M	S
1695	09	TUNNEL			V	M	S
1695	10	TURBOJET			V		S
1695	08	VELOCITY	N		V	M	S
1695	10	WAVE				M	S
1695	10	WING	N		V	M	S
1695	09	ZERO			V		S
1696	08	AXIALLY			V	M	S
1696	09	BENEATH			V	M	
1696	07	BOUNDARY			V	M	S
1696	07	CENTRE			V	M	
1696	10	CHAMBER			V	M	S
1696	07	CHORDWISE			V	M	
1696	07	COEFFICIENT			V		
1696	07	COORDINATE			V	M	S
1696	09	DIAMETER	N		V	M	S
1696	09	DIRECTION		T	V	M	
1696	10	EXHAUSTING		T	V		S
1696	10	FLAT		T		M	S
1696	09	FLOW		T	V	M	S
1696	08	FORCE	N		V	M	S
1696	09	FREE		T	V	M	
1696	08	INCREMENTAL			V	M	

1696	08	INTERFERENCE	N		V		
1696	10	JET	N	T			S
1696	07	LAYER					S
1696	10	LOAD	N	T	V		S
1696	09	MACH	N	T	V		
1696	08	NORMAL				M	S
1696	08	NOZZLE			V		S
1696	10	PLATE		T	V	M	
1696	09	POSITION	N		V	M	
1696	09	PRESSURE	N	T			S
1696	09	RATIO			V	M	S
1696	10	ROCKET		T	V	M	S
1696	08	SEPARATION	N			M	
1696	08	SONIC			V	M	S
1696	09	SPANWISE		T	V	M	S
1696	09	STATIC			V	M	
1696	09	STREAM		T	V	M	S
1696	09	SUPERSONIC			V	M	S
1696	08	SYMMETRIC			V		S
1696	10	THROAT			V	M	
1696	08	THRUST	N		V	M	S
1696	09	TOTAL					S
1696	08	TWODIMENSIONAL				M	S
1696	09	VERTICAL				M	S
1696	10	WING	N	T	V	M	S
1697	09	DISTRIBUTION	N		V		S
1697	10	DOWNSTREAM				M	S
1697	10	EXHAUST	N		V	M	S
1697	10	FIRING	N	T			S
1697	10	FLAT				M	S
1697	09	FLOW			V		S
1697	08	FORCE			V	M	S
1697	10	INTERFERENCE			V		S
1697	10	JET		T		M	
1697	08	LOCATION	N		V	M	S
1697	09	MACH	N		V	M	S
1697	09	MEASUREMENT	N		V		S
1697	07	NORMAL			V		S
1697	10	PLATE					S
1697	09	PRESSURE				M	
1697	10	ROCKET		T		M	
1697	08	SHADOWGRAPH			V	M	S
1697	09	SUPERSONIC				M	S
1697	08	THRUST	N			M	S
1697	10	UPSTREAM					S
1697	10	WING	N		V	M	S
1698	06	ACCELERATION	N		V	M	S
1698	09	AERODYNAMIC			V	M	S
1698	09	ANGLE			V		S
1698	09	ASPECT		T	V	M	S
1698	09	ATTACK	N		V	M	S
1698	09	CALCULATION	N		V	M	

1698	07	CONTINUOUS			V		
1698	08	DOWNWASH	N		V	M	S
1698	08	EDGED			V		S
1698	07	FINAL			V		
1698	10	FINITE		T	V		S
1698	08	GUST	N		V	M	S
1698	08	INDICIAL				M	S
1698	09	INERTIA	N			M	
1698	09	INFINITE			V	M	S
1698	10	LIFT	N	T	V		S
1698	06	LOADED			V		
1698	08	OSCILLATION	N		V	M	S
1698	08	PENETRATION			V		S
1698	09	RATIO		T	V	M	S
1698	08	SHARP				M	S
1698	07	STARTING			V		S
1698	10	UNSTEADY		T	V	M	S
1698	06	VERTICAL			V	M	S
1698	08	WAKE	N		V		S
1698	09	WING	N	T	V	M	
1699	07	ASPECT			V	M	S
1699	09	CALCULATION	N				
1699	09	CHANGE				M	
1699	09	COEFFICIENT		T	V	M	S
1699	10	DELTA			V		
1699	07	DISTRIBUTION	N			M	S
1699	06	EDGED				M	
1699	10	ELLIPTIC				M	S
1699	09	FINITE		T	V	M	
1699	09	FLOW	N	T	V	M	S
1699	09	FUNCTION	N	T			S
1699	06	GUST	N		V	M	S
1699	10	HARMONICALLY			V	M	S
1699	09	INCOMPRESSIBLE		T	V		S
1699	10	INDICIAL		T	V	M	S
1699	00	LIFT		T		M	S
1699	10	MOTION	N			M	S
1699	05	NORMAL			V	M	
1699	10	OSCILLATING					S
1699	06	PENETRATION			V	M	S
1699	09	PURE				M	S
1699	07	RATIO	N		V	M	S
1699	10	RECTANGULAR			V		S
1699	06	SHARP					
1699	10	SINKING			V	M	S
1699	09	SPAN	N	T	V	M	S
1699	08	SPANWISE			V	M	S
1699	09	SPEED	N		V		
1699	09	SUDDEN			V		
1699	10	TAPERED			V	M	S
1699	10	TRANSITIONAL			V	M	S
1699	10	UNSTEADY			V	M	S
1699	10	WING	N	T			S

1700	09	CLASSICAL				M	S
1700	07	COEFFICIENT	N		V		S
1700	07	CURVE	N		V	M	S
1700	07	DETERMINATION	N				S
1700	07	EDGED			V	M	S
1700	09	EQUATION			V	M	S
1700	09	FLOW	N		V	M	S
1700	08	FLUTTERING			V	M	
1700	09	FORMULA	N		V	M	S
1700	07	FORWARD			V	M	S
1700	07	FREQUENCY			V		S
1700	08	INDICIAL			V	M	
1700	10	KIRSCHHOFF			V	M	S
1700	10	LIFT	N	T			S
1700	08	LOADING	N		V		S
1700	08	MOMENT	N		V	M	
1700	07	MOTION	N		V		S
1700	08	OSCILLATING			V	M	S
1700	08	PITCHING	N		V	M	S
1700	07	RESPONSE			V	M	S
1700	08	REVERSED			V	M	S
1700	08	ROTATING			V		S
1700	08	SINKING	N				S
1700	07	SLOWLY			V	M	S
1700	09	SOLUTION	N		V	M	S
1700	06	STARTING				M	S
1700	09	SUBSONIC			V	M	S
1700	09	SUPERSONIC			V		S
1700	09	THREEDIMENSIONAL		T	V		S
1700	10	TRANSIENT			V		S
1700	08	TRIANGULAR			V		S
1700	09	TWODIMENSIONAL		T	V	M	
1700	10	UNSTEADY		T		M	S
1700	10	WAVE			V		S
1700	10	WING	N		V	M	S
1701	09	AEROFOIL	N	T		M	S
1701	08	AILERON				M	S
1701	07	APPARENT				M	
1701	10	CIRCULATORY			V	M	S
1701	09	COEFFICIENT	N	T			S
1701	07	COMPRESSIBLE				M	
1701	09	DETERMINATION	N	T	V		
1701	08	EDGED			V	M	S
1701	07	EFFECT	N				S
1701	09	FLOW	N		V		
1701	06	FLUTTER			V		S
1701	09	FUNCTION	N		V	M	
1701	08	GUST	N		V	M	S
1701	09	INCOMPRESSIBLE				M	
1701	10	INDICIAL		T	V	M	
1701	10	LIFT	N	T	V	M	S
1701	10	MACH	N	T	V		S
1701	08	MASS			V	M	
1701	10	MOMENT			V		S
1701	09	NUMERICAL		T	V		S

1701	10	OSCILLATORY		T	V	M	
1701	08	PENETRATION			V		S
1701	08	SHARP			V		S
1701	10	SINKING	N	T	V	M	S
1701	09	SUBSONIC		T	V	M	S
1701	08	TAB			V	M	
1701	09	TWODIMENSIONAL		T	V	M	
1702	09	AEROFOIL	N	T		M	S
1702	09	CALCULATION	N			M	S
1702	00	COEFFICIENT	N		V	M	S
1702	08	EDGED			V	M	
1702	09	FLOW	N		V		
1702	09	FUNCTION	N	T	V	M	S
1702	08	GUST	N				
1702	10	INDICIAL		T			
1702	10	LIFT	N	T	V		S
1702	10	MACH	N	T	V	M	
1702	10	MOMENT		T		M	
1702	09	MOTION	N		V		
1702	10	OSCILLATORY			V		
1702	08	PENETRATING			V	M	S
1702	10	PITCHING		T	V	M	
1702	0	SHARP					S
1702	10	SINKING		T			S
1702	09	SUBSONIC			V	M	S
1702	09	TWODIMENSIONAL		T	V		S
1703	08	ACCELERATION			V	M	S
1703	08	ACOUSTIC				M	S
1703	10	AEROFOIL	N	T	V		S
1703	07	APPROXIMATION	N		V	M	S
1703	07	ASPECT			V	M	S
1703	06	BIRNBAUM			V	M	S
1703	10	COMPRESSIBLE			V		S
1703	08	DISTRIBUTION	N		V	M	S
1703	10	DISTURBANCE	N		V	M	S
1703	08	DOUBLET			V	M	S
1703	08	DOWNWASH			V		S
1703	09	EQUATION	N		V		
1703	08	FIELD	N		V		S
1703	09	FLOW	N		V		S
1703	09	FLUID			V		S
1703	09	GENERALIZED			V	M	
1703	07	HIGH			V		S
1703	08	INFINITE			V	M	S
1703	09	INFINITELY			V	M	S
1703	09	INTEGRAL			V	M	S
1703	08	LORENZ			V	M	S
1703	08	OSCILLATING				M	S
1703	08	PERIODIC			V	M	S
1703	06	POSSION			V	M	S
1703	08	POTENTIAL	N		V	M	S
1703	06	PRANDTL			V	M	S

1703	08	PRESSURE			V		S
1703	08	RADIATOR	N			M	S
1703	07	RATIO	N		V		S
1703	09	SMALL			V		S
1703	08	SPAN			V	M	S
1703	08	SUPERPOSITION			V	M	S
1703	09	THEORY	N	T	V	M	S
1703	08	TRANSFORMATION	N		V		S
1703	08	VELOCITY			V	M	S
1703	08	WING	N		V		S
1704	09	AERODYNAMIC		T	V	M	
1704	08	ALLMOVABLE				M	S
1704	08	ANGLE			V	M	S
1704	07	ASPECT			V		S
1704	08	ATTACK	N		V		S
1704	09	CALCULATION	N		V	M	S
1704	08	CANTELEVERED				M	S
1704	08	CIRCULAR			V	M	S
1704	09	COEFFICIENT	N		V	M	S
1704	10	CONDITION	N		V	M	SA
1704	08	CONTROL				M	
1704	09	DISTRIBUTION	N		V	M	S
1704	00	DOWNWASH			V		
1704	09	EQUATION	N			M	
1704	10	FINITE		T	V	M	
1704	08	FLAPPING			V		S
1704	08	FLOW	N		V	M	S
1704	08	FLUTTER			V		S
1704	10	FORCE	N	T			
1704	09	FUNCTION		T	V		S
1704	09	INTEGRAL			V	M	S
1704	10	KERNEL		T	V	M	
1704	10	LIFT	N		V	M	
1704	10	MOMENT			V	M	S
1704	09	NUMERICAL					
1704	10	OSCILLATING		T	V	M	S
1704	08	OSCILLATION	N		V	M	S
1704	08	PITCHING			V		
1704	08	PLANFORM			V		S
1704	09	PRESSURE			V	M	S
1704	09	PROCEDURE	N	T	V	M	S
1704	07	RATIO	N		V	M	S
1704	08	RECTANGULAR			V		S
1704	09	SOLUTION	N		V	M	S
1704	10	STEADY		T			S
1704	09	SUBSONIC		T	V	M	S
1704	08	SURFACE	N				
1704	09	SYSTEMATIC		T	V		S
1704	08	TAIL	N		V		S
1704	07	UNIFORM					S
1704	10	WING	N	T	V	M	S
1705	09	COMPRESSIBLE			V	M	S

1705	09	DISTRIBUTION	N	T	V		
1705	10	DOWNWASH		T	V	M	
1705	09	EQUATION	N	T		M	
1705	09	FINITE		T	V		
1705	09	FLOW	N	T	V	M	
1705	09	FUNCTION	N	T		M	
1705	10	HARMONICALLY			V	M	S
1705	07	INCOMPRESSIBLE				M	
1705	09	INTEGRAL		T	V		
1705	10	KERNEL		T	V		S
1705	10	LIFT		T		M	
1705	09	MOTION			V		S
1705	10	OSCILLATING		T	V	M	S
1705	09	RELATION			V	M	
1705	07	SONIC			V	M	
1705	09	SUBSONIC		T		M	S
1705	10	WING	N	T		M	
1706	09	AEROFOIL	N				S
1706	10	ALTERNATING			V	M	S
1706	08	ANALOGY			V	M	S
1706	08	EDGED			V		S
1706	08	ELECTRICAL			V		
1706	09	FLOW	N	T	V		
1706	10	FOURIER					S
1706	09	FUNCTION	N		V	M	S
1706	08	GUST	N			M	
1706	10	INDICIAL			V	M	S
1706	08	KUSSNER			V		S
1706	10	LIFT	N		V	M	S
1706	09	NONSTATIONARY		T		M	S
1706	08	PENETRATING			V	M	S
1706	09	RECIPROCAL		T	V	M	S
1706	09	RELATION	N	T	V		S
1706	08	SHARP			V		S
1706	10	THEODORSEN			V	M	S
1706	09	THEORY	N	T		M	S
1706	10	TRANSFORMATION	N		V	M	
1706	00	TRANSIENT				M	
1706	10	WAGNER				M	S
1707	10	AERODYNAMIC				M	S
1707	08	ANGLE	N		V		S
1707	07	COEFFICIENT	N				S
1707	08	CONDUCTION	N		V		S
1707	08	CONDUCTIVITY	N		V	M	S
1707	08	CONVECTIVE			V		S
1707	10	COOLING	N			M	
1707	08	DIAMETER	N		V		S
1707	08	DISTRIBUTION	N		V		S
1707	10	EDGE	N			M	S
1707	08	EMISSIVITY	N		V		S
1707	09	FLOW	N		V		S
1707	10	GLIDER			V		S

1707	08	GRAPHITE			V		S
1707	10	HEATING	N		V		S
1707	10	HYPERSONIC		T			
1707	10	LEADING				M	
1707	08	LIFT				M	
1707	10	NOSE	N	T		M	S
1707	10	RADIATION				M	S
1707	10	REGION	N	T	V	M	S
1707	00	SHAPE	N	T		M	S
1707	08	SKIN			V		S
1707	10	STAGNATION		T	V	M	S
1707	08	SWEEP				M	
1707	08	TEMPERATURE			V		S
1707	08	THICKNESS	N		V	M	S
1707	10	VEHICLE	N		V		S
1707	08	WEDGE					S
1708	09	AERODYNAMIC		T		M	S
1708	09	ANGLE			V		S
1708	09	ATTACK	N		V	M	S
1708	09	CHARACTERISTIC	N	T	V		S
1708	09	CONFIGURATION	N		V		S
1708	10	CONTROL	N		V	M	S
1708	08	DEFLECTION	N		V		
1708	08	DIFFERENTIAL			V	M	S
1708	08	DIRECTIONAL			V	M	S
1708	08	DRAG				M	
1708	08	ELEVON			V	M	S
1708	09	FLOW	N		V	M	
1708	10	GLIDER					S
1708	09	HYPERSONIC		T	V		
1708	08	LATERAL					S
1708	10	LIFT	N		V	M	
1708	10	LIFTING				M	S
1708	10	LONGITUDINAL			V	M	S
1708	10	MACH	N				S
1708	08	MOMENT	N		V	M	S
1708	09	PERFORMANCE	N		V		S
1708	08	PITCHING			V	M	S
1708	07	RATIO	N		V	M	S
1708	10	REENTRY		T	V	M	S
1708	08	ROLLING					S
1708	08	RUDDER			V		S
1708	08	SIDESLIP	N		V	M	S
1708	10	STABILITY	N		V		
1708	09	SUPERSONIC		T			S
1708	09	TEST	N		V	M	S
1708	09	TUNNEL			V	M	S
1708	09	WIND			V	M	S
1708	10	WINGED		T			S
1708	08	YAW			V	M	S
1709	09	AERODYNAMIC		T	V	M	
1709	09	ANGLE		T			S

1709	09	ATTACK	N	T	V	M	
1709	08	AXIAL				M	
1709	00	BALANCE			V		S
1709	06	CHAMBER			V	M	S
1709	09	CHARACTERISTIC	N	T	V	M	S
1709	10	CLIPPED			V		
1709	07	COEFFICIENT	N		V	M	
1709	08	DEFLECTION	N		V		S
1709	10	DELTA			V	M	
1709	08	DRAG			V		S
1709	09	FLOW	N		V		S
1709	10	FOLDING		T	V		S
1709	08	FORCE			V	M	S
1709	10	GLIDER		T	V	M	
1709	06	INTERFERENCE	N				S
1709	08	LIFT			V	M	
1709	10	LONGITUDINAL		T			S
1709	07	MAXIMUM			V	M	S
1709	08	MOMENT			V	M	
1709	10	PANEL	N	T	V	M	S
1709	05	PRESSURE				M	S
1709	07	RATIO	N		V	M	S
1709	10	REENTRY		T		M	S
1709	06	REYNOLDS	N				
1709	08	STABILITY	N			M	S
1709	10	STATIC			V	M	S
1709	06	SUPPORT				M	S
1709	10	SWEPTBACK	N		V	M	S
1709	06	SYSTEM			V	M	
1709	09	TEST	N		V	M	S
1709	10	TIP		T	V	M	S
1709	10	TRANSONIC		T		M	S
1709	09	TUNNEL			V		S
1709	09	WIND				M	S
1709	10	WING		T			
1710	07	BODY			V	M	S
1710	10	BOUNDARY		T			S
1710	10	CRITICAL			V	M	S
1710	07	DEGREE			V	M	S
1710	09	DETERMINATION	N		V	M	S
1710	10	DISK	N				S
1710	07	DISTRIBUTION	N			M	
1710	08	ELEMENT	N		V	M	S
1710	07	FLOW	N				S
1710	10	HEIGHT	N	T		M	S
1710	10	LAMINAR					S
1710	10	LAYER	N	T	V	M	S
1710	07	LENGTH			V	M	
1710	08	LOCATION	N		V		S
1710	08	MACH			V	M	S
1710	07	NATURAL					
1710	08	NUMBER	N			M	S
1710	08	PRESSURE					
1710	10	PROMOTION	N			M	S
1710	08	REYNOLDS			V		S
1710	10	ROUGHNESS		T	V		

1710	10	SANDPAPER	N		V		S
1710	08	SHAPE	N		V	M	S
1710	10	SPANWISE				M	S
1710	07	SUBSONIC			V		S
1710	07	SUPERSONIC			V	M	S
1710	10	THREEDIMENSIONAL			V	M	S
1710	10	TRANSITION		T		M	S
1710	09	TUNNEL			V		S
1710	08	TURBULENCE	N				S
1710	10	TWODIMENSIONAL			V	M	S
1710	09	WIND					S
1710	10	WIRE	N		V	M	S
1711	09	AERODYNAMIC		T	V		S
1711	08	ANGLE		T	V	M	S
1711	08	ATTACK	N	T	V	M	
1711	09	CHARACTERISTIC	N	T	V	M	S
1711	09	COEFFICIENT	N		V	M	S
1711	09	CONFIGURATION		T	V		S
1711	08	CONTROL	N		V	M	S
1711	08	DEFLECTION	N				S
1711	10	DELTA		T	V	M	S
1711	08	DRAG			V		S
1711	09	FLOW	N		V	M	S
1711	10	FOLDING		T	V	M	
1711	08	HEATING	N		V	M	S
1711	08	LATERAL			V	M	S
1711	08	LIFT					S
1711	10	LIFTING					
1711	08	LONGITUDINAL					S
1711	08	MOMENT			V		S
1711	10	PANEL	N	T	V	M	
1711	08	PITCHING			V	M	S
1711	08	PLANFORM	N		V		
1711	08	RATIO	N		V		
1711	10	REENTRY		T			S
1711	08	REVERSAL	N		V	M	S
1711	07	SIZE	N		V	M	S
1711	08	STABILITY	N		V		S
1711	09	SUBSONIC		T	V		
1711	10	SWEPTBACK				M	
1711	09	TEST	N		V	M	S
1711	10	TIP		T		M	
1711	09	TUNNEL			V	M	
1711	08	UNFOLDING			V	M	
1711	09	WIND					S
1711	10	WING		T	V	M	
1712	09	AERODYNAMIC		T		M	S
1712	08	ANGLE				M	S
1712	09	ASPECT		T	V	M	S
1712	08	ATTACK	N		V		
1712	09	CHARACTERISTIC	N	T		M	S
1712	09	CONFIGURATION	N		V	M	
1712	09	CONTOUR	N	T		M	S

1712	07	CURVE			V	M	S
1712	08	DRAG			V		S
1712	10	EDGE		T	V		S
1712	10	ELLIPTIC				M	S
1712	10	FLAT				M	
1712	09	FLOW	N		V		S
1712	08	FUSELAGE			V	M	
1712	10	GLIDER					S
1712	09	HIGHLY			V	M	S
1712	10	LEADING		T		M	
1712	10	LIFT	N		V	M	S
1712	10	LONGITUDINAL		T		M	
1712	09	LOW		T	V		
1712	10	PARABOLIC			V		S
1712	10	PLATE			V		S
1712	09	RATIO	N	T	V	M	S
1712	10	RECTANGULAR				M	S
1712	10	REENTRY					
1712	08	REYNOLDS	N				S
1712	07	SIZE	N			M	S
1712	07	SLOPE	N		V		S
1712	10	STABILITY	N		V		S
1712	09	SUBSONIC				M	
1712	10	SWEPT			V	M	
1712	10	TRIANGULAR				M	S
1712	10	WING	N	T	V	M	S
1713	09	ANGLE	N	T	V	M	S
1713	09	ATTACK	N	T		M	
1713	10	BLUNTED		T		M	S
1713	08	BOATTAIL				M	S
1713	07	COEFFICIENT	N		V	M	S
1713	09	CONFIGURATION		T	V	M	S
1713	08	CURVE			V	M	
1713	10	DEGREE	N	T	V	M	S
1713	10	DIHEDRAL		T	V		S
1713	08	DRAG	N		V		S
1713	09	FLOW			V		S
1713	10	GLIDER		T	V	M	
1713	09	HYPERSONIC			V		
1713	08	INCIDENCE	N		V	M	
1713	08	LIFT			V	M	
1713	10	LONGITUDINAL		T	V		
1713	10	MACH	N	T			
1713	09	MODEL				M	S
1713	08	MOMENT	N				S
1713	08	NOSE			V		
1713	08	PITCHING					S
1713	07	RATIO	N		V		S
1713	10	REENTRY		T			S
1713	08	SLOPE	N		V		
1713	10	STABILITY	N	T	V	M	
1713	10	STATIC		T	V	M	
1713	10	SWEPTBACK			V	M	S
1713	09	TEST	N			M	S
1713	08	TRIM				M	S

1717	07	AERODYNAMIC			V	M	S
1717	00	AFTERBODY	N		V	M	S
1717	08	ALTITUDE	N			M	
1717	09	ANGLE		T	V	M	S
1717	09	ARBITRARY		T	V	M	S
1717	10	ATMOSPHERE	N	T	V	M	
1717	09	ATTACK	N	T			S
1717	07	BASE	N		V	M	
1717	09	BEHAVIOUR	N		V	M	SA
1717	10	BLUNTED		T	V		S
1717	09	BODY			V		S
1717	09	CALCULATION	N		V	M	S
1717	10	CONE		T	V	M	S
1717	08	CONICAL				M	S
1717	08	CONVECTION			V	M	
1717	10	DEGREE		T			S
1717	09	DYNAMIC				M	S
1717	10	ENTERING		T	V	M	S
1717	08	ENTRY			V		S
1717	09	EQUATION				M	S
1717	07	FLAT			V	M	
1717	07	FORWARD			V	M	S
1717	09	FREEDOM			V	M	S
1717	08	HEATING	N		V		
1717	10	MARTIAN		T	V	M	S
1717	09	MOTION	N	T	V		
1717	08	NOSE			V	M	S
1717	08	OSCILLATORY			V	M	S
1717	10	PITCHING		T		M	S
1717	08	PLANETARY			V	M	
1717	08	POINT			V		S
1717	10	PROBE			V	M	S
1717	09	RATE	N	T	V		
1717	09	RIGID			V	M	S
1717	09	SHORT		T	V		
1717	09	SIX				M	
1717	0	SPIN			V	M	S
1717	08	STABLE			V		
1717	08	STAGNATION			V	M	
1717	08	STATICALLY			V	M	S
1717	08	TRIM			V	M	S
1717	08	TUMBLING				M	S
1717	10	VEHICLE	N		V	M	S
1719	08	ALTITUDE	N		V		S
1719	09	ANALYTICAL			V	M	S
1719	08	ANGLE				M	S
1719	05	APPLIED			V		S
1719	10	ATMOSPHERE	N	T	V		S
1719	08	ATTACK			V	M	S
1719	08	BODY		T	V		S
1719	10	CENTERING					S
1719	07	CESSATION			V	M	S
1719	05	COEFFICIENT	N		V	M	S
1719	06	DAMPING			V	M	S
1719	06	DRAG			V	M	S

1719	09	EQUATION	N			M	S
1719	10	EXPONENTIAL				M	
1719	09	FLAT			V	M	S
1719	06	FORCE	N				S
1719	08	LIBRATION			V	M	S
1719	06	LIFT	N		V	M	S
1719	09	LINEAR			V	M	S
1719	08	MOMENT	N		V	M	S
1719	09	MOTION	N		V		
1719	07	ONSET			V		S
1719	08	OSCILLATION	N		V		S
1719	06	PITCH			V		
1719	10	PLANETARY			V	M	S
1719	00	PLATE	N		V		S
1719	08	REVOLUTION	N		V		S
1719	08	SLENDER				M	S
1719	09	SOLUTION	N		V	M	S
1719	07	TRANSITION			V	M	S
1719	10	TUMBLING		T	V	M	S
1728	06	BOUNDARY			V		S
1728	05	CONDITION	N		V		SA
1728	09	CONTINUOUS		T	V	M	S
1728	08	CURVATURE	N		V	M	S
1728	05	DEPENDENT			V		S
1728	09	DETERMINATION	N		V		
1728	08	ENGINE				M	S
1728	08	FLUCTUATION	N		V	M	S
1728	09	FREE		T	V	M	S
1728	10	FREQUENCY	N				S
1728	10	FUSELAGE					S
1728	08	MODE			V	M	S
1728	09	NATURAL			V	M	S
1728	08	NOISE			V	M	
1728	09	NORMAL			V	M	S
1728	10	PANEL	N	T		M	S
1728	07	POWER			V	M	S
1728	07	PRESSURE			V		S
1728	08	SHAPE	N				S
1728	10	SKIN		T	V		
1728	08	SPECTRA	N		V	M	S
1728	08	STRESS			V	M	
1728	10	STRINGER	N	T	V		S
1728	07	SUBJECTED			V	M	S
1728	06	SUPPORTING			V	M	S
1728	05	TIME			V	M	
1728	00	VIBRATION	N	T	V	M	
1729	06	BEAM	N		V	M	
1729	09	CONTINUOUS		T	V	M	S
1729	06	DAMPING	N			M	S
1729	07	DISTRIBUTION	N		V		S
1729	08	ENGINE			V	M	S
1729	07	EXPOSED			V	M	S

1729	08	FREQUENCY				M	S
1729	08	FUSELAGE			V	M	S
1729	08	JET			V	M	S
1729	09	LOADING	N	T	V	M	
1729	10	MODAL			V	M	
1729	08	MODE			V		
1729	08	NOISE	N		V		S
1729	07	NORMAL			V		S
1729	10	PANEL	N	T	V	M	
1729	10	POWELL				M	
1729	09	POWER					S
1729	09	PREDICTION	N		V	M	S
1729	09	PRESSURE			V		S
1729	09	RANDOM		T	V		S
1729	10	RESPONSE	N			M	S
1729	09	SINGLE			V	M	S
1729	10	SKIN		T	V	M	S
1729	09	SPAN				M	
1729	10	SPECTRA	N		V	M	S
1729	09	STATISTICAL			V		S
1729	10	STIFFENER		T	V	M	S
1729	10	STRESS		T	V		S
1729	09	SUPERPOSITION					S
1729	09	THEORY			V	M	S
1729	08	VIBRATION	N			M	S
1748	09	AERODYNAMIC		T	V	M	S
1748	06	BALANCE	N		V		
1748	06	CALCULATION	N		V		S
1748	06	CHORD					S
1748	09	COMPRESSIBLE				M	
1748	10	CONTROL		T		M	S
1748	06	DAMPING			V		
1748	10	DERIVATIVE	N	T	V	M	S
1748	06	DIETZE			V	M	S
1748	09	FLOW	N				S
1748	08	FREQUENCY			V	M	
1748	09	INCOMPRESSIBLE			V		S
1748	06	MACH	N		V		
1748	06	METHOD	N		V	M	S
1748	08	PARAMETER	N		V		S
1748	06	RATIO	N		V		S
1748	10	SURFACE	N	T	V	M	S
1748	08	TAB	N		V		S
1748	10	WING	N	T	V		S
1772	10	AIR			V		S
1772	08	ANGLE	N		V	M	S
1772	08	ATTACK	N		V	M	S
1772	10	AXIAL			V		
1772	10	BLADE	N	T	V	M	S
1772	10	BLOWER			V	M	S
1772	10	BLOWING					S
1772	10	CASCADE					

1772	09	CHARACTERISTIC	N			M	
1772	07	COEFFICIENT	N		V	M	S
1772	10	COMPRESSOR		T	V		S
1772	09	EDGE	N			M	S
1772	10	FLAP		T	V	M	S
1772	09	FLOW			V	M	S
1772	10	JET	N	T	V	M	S
1772	08	LIFT			V	M	S
1772	09	NACA				M	S
1772	07	PRESSURE			V		S
1772	08	RISE	N		V	M	S
1772	08	ROTATING				M	S
1772	09	SECTION					S
1772	08	STALL	N		V	M	S
1772	09	TEST	N				S
1772	09	THICKENED					S
1772	09	TRAILING			V	M	S
1772	09	TUNNEL			V	M	
1772	08	TURNING			V		S
1779	07	ASPECT			V	M	S
1779	07	ASYMPTOTIC					S
1779	07	BEHAVIOUR	N		V	M	SA
1779	09	CALCULATION	N	T	V		
1779	07	COEFFICIENT	N		V	M	
1779	07	COMPRESSIBLE			V	M	S
1779	08	DELTA			V	M	S
1779	08	ELLIPTICAL			V		S
1779	07	FLOW	N		V	M	S
1779	09	FUNCTION	N	T	V	M	
1779	10	GUST	N	T		M	S
1779	07	INCOMPRESSIBLE					
1779	08	INDICIAL			V	M	S
1779	10	LIFT		T	V	M	S
1779	07	LOW			V	M	
1779	07	MACH	N		V		S
1779	08	OSCILLATION	N	T	V	M	S
1779	08	OSCILLATORY			V	M	S
1779	08	PENETRATION	N		V	M	S
1779	07	RATIO	N		V	M	S
1779	07	RECIPROCAL					
1779	08	RECTANGULAR			V		SA
1779	07	RELATION			V	M	S
1779	08	RESPONSE	N		V	M	S
1779	10	RIGID		T	V		S
1779	08	SINKING		T	V	M	
1779	10	SINUSOIDAL		T	V		
1779	07	SONIC			V	M	S
1779	07	SUBSONIC			V	M	S
1779	07	SUPERSONIC			V		S
1779	07	TOTAL					S
1779	07	TWODIMENSIONAL			V		S
1779	10	UNSTEADY		T		M	S
1779	07	VANISHING			V		
1779	07	VELOCITY	N		V	M	S
1779	07	VERTICAL			V	M	

1779	07	WIDE			V	M	S
1779	10	WING	N	T	V	M	S
1782	08	ANGLE	N				S
1782	08	ASPECT			V		
1782	09	CALCULATION	N			M	
1782	10	DEGREE		T		M	
1782	10	DERIVATIVE	N	T	V	M	
1782	08	DIHEDRAL					S
1782	06	DISCRETE				M	S
1782	06	FINITE			V		S
1782	08	HORIZONTAL	N		V	M	S
1782	06	HORSESHOE				M	
1782	08	INTERSECTING			V		S
1782	10	LOAD	N	T	V		S
1782	06	METHOD	N		V	M	S
1782	08	POSITION				M	S
1782	08	RATIO	N		V		S
1782	06	RECTANGULAR			V	M	
1782	10	ROLL	N	T		M	S
1782	10	SIDESLIP	N	T	V		S
1782	06	SIDEWASH			V	M	
1782	10	SPAN		T	V	M	S
1782	10	STABILITY		T			
1782	10	STEADY		T			
1782	06	STEP				M	S
1782	10	SUBSONIC		T		M	S
1782	10	SURFACE	N	T		M	S
1782	10	SWEPTBACK		T	V	M	
1782	06	TABLE			V	M	
1782	10	TAIL	N	T	V		S
1782	10	UNSWEPT		T	V	M	S
1782	06	VALUE	N		V		
1782	08	VERTICAL			V	M	
1782	06	VORTEX	N		V		S
1783	06	AERODYNAMIC			V	M	S
1783	09	AEROPLANE	N	T	V	M	S
1783	10	ARBITRARY		T	V	M	S
1783	09	CALCULATION				M	S
1783	06	COMPRESSIBILITY			V	M	S
1783	06	CORRECTION	N			M	S
1783	06	DATA	N				S
1783	09	DISTRIBUTION	N		V		S
1783	08	DIVERGENCE			V	M	S
1783	06	DOWNWASH			V	M	S
1783	08	DYNAMIC			V	M	S
1783	06	EFFECT	N			M	S
1783	06	ELASTIC			V	M	
1783	06	ELASTICITY			V	M	S
1783	08	EXTERNAL			V		S
1783	06	FLEXIBILITY			V		
1783	08	FUSELAGE	N		V	M	S
1783	06	HORSESHOE			V		
1783	06	INTERFERENCE	N		V	M	S
1783	06	L-METHOD			V		S

1783	10	LOAD					S
1783	09	MACH			V	M	
1783	08	MATRIX	N		V	M	S
1783	09	METHOD	N	T		M	S
1783	06	MODEL			V		S
1783	10	PLANFORM		T	V		S
1783	08	PRESSURE	N		V	M	S
1783	10	SPAN			V	M	S
1783	10	STATE		T	V	M	S
1783	10	STEADY		T	V		S
1783	10	STIFFNESS		T	V	M	S
1783	08	STORE			V		S
1783	08	STORES	N		V		
1783	06	STRUCTURAL			V	M	
1783	10	SUBSONIC		T		M	S
1783	08	SUBSTANTIAL	N		V	M	
1783	08	SWEPT			V	M	S
1783	08	TAILBOOM				M	S
1783	08	TAILLESS			V	M	S
1783	06	TUNNEL			V		
1783	06	TWIST			V	M	
1783	06	VORTICES	N			M	S
1783	06	WEISSINGER			V	M	S
1783	06	WIND			V		S
1783	10	WING	N	T	V	M	S
1785	08	BOUNDARY			V	M	
1785	09	CALCULATION	N		V		S
1785	06	CIRCULAR			V		S
1785	08	CORNER	N		V	M	S
1785	08	CURVATURE	N		V	M	S
1785	10	CYLINDER	N	T	V	M	S
1785	00	DRAG	N		V	M	S
1785	06	ECCENTRICITY	N				S
1785	08	ELLIPTIC				M	S
1785	08	EQUATION			V		
1785	10	FLOW		T	V	M	S
1785	10	FLUID		T	V		S
1785	08	GENERATORS	N		V	M	S
1785	08	INCOMPRESSIBLE					S
1785	08	LAYER			V	M	S
1785	08	MOTION	N		V		
1785	10	PARALLEL			V		S
1785	08	POHLHAUSEN			V	M	S
1785	08	RADIUS					S
1785	08	SOLUTION	N		V	M	S
1785	08	UNIFORM			V	M	S
1786	08	ANGLE			V		S
1786	06	ARBITRARY			V		S
1786	08	CIRCULAR			V		
1786	08	CORNER	N		V	M	
1786	08	CROSSECTION	N		V		
1786	10	CYLINDER	N	T	V	M	S

1786	06	DRAG	N		V	M	S
1786	08	DURATION			V	M	S
1786	06	EXCESS			V	M	
1786	06	FLAT			V	M	S
1786	10	FRICTION	N	T	V	M	S
1786	10	INFINITE		T	V	M	S
1786	10	LENGTH	N	T	V	M	S
1786	08	MOTION	N			M	
1786	09	MOVING		T	V	M	S
1786	08	NUMBER			V	M	S
1786	10	PARALLEL		T	V	M	S
1786	06	PLATE				M	
1786	08	SHAPE	N		V		S
1786	10	SKIN		T			S
1786	09	SOLUTION	N				S
1786	08	THREEDIMENSIONAL					S
1786	08	TIME			V		S
1786	08	UNIDIRECTIONAL			V	M	S
1786	08	VISCOUS			V		
1786	08	WIDTH	N			M	S
1787	10	ARBITRARY		T	V	M	S
1787	08	ASYMPTOTIC			V	M	S
1787	06	BOUNDARY			V		S
1787	06	CIRCULAR			V		S
1787	04	CONDUCTION	N		V	M	S
1787	06	CROSS				M	
1787	10	CYLINDER	N	T	V	M	S
1787	06	DISTRIBUTION	N		V	M	S
1787	06	DRAG			V		S
1787	06	ELLIPTIC			V	M	S
1787	08	EXPANSION			V		S
1787	10	FLUID	N		V	M	S
1787	08	FORMULA	N		V		S
1787	06	FRICTION	N		V	M	S
1787	06	FRICTIONAL			V	M	
1787	04	HEAT			V	M	S
1787	09	INCOMPRESSIBLE			V	M	S
1787	06	JOUKOWSKI			V	M	S
1787	06	LAYER			V	M	S
1787	08	LENGTH	N		V	M	S
1787	09	MOTION			V	M	S
1787	08	MOVING					S
1787	08	PARALLEL			V		S
1787	10	PROBLEM	N	T		M	S
1787	06	PROFILE				M	S
1787	10	RAYLEIGH		T	V	M	
1787	06	SECTION			V	M	
1787	10	SHAPE	N	T	V		S
1787	06	SKIN			V		S
1787	09	SOLUTION	N		V	M	S
1787	06	THEORY	N		V		S
1787	08	UNIFORM					
1787	08	VELOCITY			V	M	S
1787	09	VISCOUS			V	M	S
1787	06	VORTICITY				M	S
1788	06	ANGLE				M	S

			N	T	V	M	S
1788	09	APPROXIMATE		T			
1788	10	ARBITRARY		T	V		S
1788	10	AREA	N			M	S
1788	09	BOUNDARY		T	V		
1788	06	CONCAVE			V	M	
1788	06	CONVEX			V	M	S
1788	06	CORNER	N		V	M	S
1788	10	CROSS		T	V	M	S
1788	10	CYLINDER	N	T	V	M	S
1788	10	DISPLACEMENT					
1788	08	DISTANCE			V	M	S
1788	09	DISTRIBUTION	N		V		S
1788	08	EDGE	N		V	M	S
1788	06	ELLIPTIC			V		S
1788	06	FINITE			V	M	S
1788	06	FLAT				M	
1788	08	FORCE	N		V		S
1788	10	FRICTION	N		V	M	
1788	09	GENERATORS	N		V	M	S
1788	06	IN	N				
1788	09	LAYER	N	T	V		S
1788	08	LEADING			V	M	S
1788	00	LOCALLY			V	M	S
1788	06	LONG			V		
1788	07	METHOD	N		V	M	S
1788	09	PARALLEL			V		S
1788	06	PLATE	N		V		S
1788	08	POHLHAUSEN			V	M	S
1788	06	POLYGON			V		S
1788	07	PROFILE	N		V		S
1788	06	REENTRANT			V		S
1788	08	RETARDING			V	M	S
1788	10	SECTION	N	T		M	S
1788	10	SEMIINFINITE		T		M	S
1788	10	SKIN					S
1788	09	STREAM			V	M	S
1788	09	THEORY	N	T	V	M	S
1788	08	THICKNESS	N		V	M	S
1788	07	VELOCITY			V	M	S
1788	08	VISCOUS			V	M	
1792	06	ABOUT			V		S
1792	06	ADVERSE			V	M	S
1792	09	AERODYNAMIC			V	M	S
1792	09	AIRCRAFT	N	T	V	M	S
1792	06	AIRSPEED			V		S
1792	06	ANGLE			V		
1792	08	ARRANGEMENTS	N		V	M	S
1792	06	ATTACHED			V	M	S
1792	06	AVRO	N		V	M	S
1792	06	BLOWING			V	M	S
1792	06	BLOWN			V		S
1792	08	BODY			V	M	S
1792	08	BOUNDARY			V		
1792	06	BUFFETING	N		V		S
1792	00	CENTRE	N		V		S
1792	06	CHORD			V	M	S
1792	08	CONTROL	N		V		S
1792	06	DAMPING	N		V		S

1792	06	DEGREE	N		V		S
1792	06	DERIVATIVE	N		V	M	S
1792	06	DIRECTIONAL			V	M	S
1792	06	EDGE	N		V		S
1792	06	EFFECT	N		V	M	S
1792	06	FLAP	N		V		S
1792	06	FLIGHT			V	M	S
1792	08	FLOW	N		V	M	S
1792	06	FULLY			V	M	S
1792	06	GLIDE			V	M	S
1792	06	GROUND			V		S
1792	06	HANDLING			V	M	S
1792	09	HIGH		T	V	M	
1792	06	HOLDING	N		V	M	S
1792	06	KNEE	N		V	M	S
1792	06	LATERAL			V	M	S
1792	08	LAYER			V	M	S
1792	06	LEADING			V		S
1792	06	LIFT	N		V	M	S
1792	06	LONGITUDINAL			V	M	S
1792	10	LOW		T	V	M	S
1792	06	MACH	N		V	M	S
1792	06	MANOEUVRE			V	M	S
1792	06	MARGIN	N		V	M	S
1792	06	MAXIMUM			V	M	S
1792	06	MODEL	N		V	M	S
1792	06	MOMENT			V	M	S
1792	06	NEARTRIANGULAR			V	M	S
1792	06	PATH			V	M	S
1792	06	PHUGOID			V		S
1792	06	PILOTING	N		V		S
1792	06	PITCH	N		V		S
1792	06	PITCHUP	N		V	M	S
1792	06	PLANE			V	M	S
1792	08	PLANFORM	N		V	M	
1792	09	PROBLEM		T	V	M	S
1792	06	PROXIMITY			V		S
1792	06	QUALITY	N		V	M	S
1792	06	RAE			V		S
1792	06	RATIO			V	M	S
1792	06	ROLLING			V		S
1792	06	ROTARY			V		S
1792	06	SECTION	N		V	M	S
1792	08	SEPARATION	N		V		S
1792	08	SHAPE			V		S
1792	06	SHARP			V		
1792	06	SIDESLIP	N		V	M	S
1792	08	SLENDER			V	M	S
1792	09	SPEED	N	T	V		S
1792	08	STABILITY	N		V		S
1792	06	STATIC			V		S
1792	00	STREAMWISE			V	M	S
1792	06	SUCTION			V	M	S
1792	09	SUPERSONIC			V	M	S
1792	08	SWEPT			V	M	S
1792	08	SWEPTBACK				M	S

1792	06	TEST	N		V		S
1792	06	THICKNESS			V		S
1792	06	TRAILING			V	M	S
1792	06	TUNNEL			V	M	S
1792	06	VERTICAL			V	M	S
1792	06	WIND			V		S
1792	08	WING	N		V	M	S
1792	06	YAWING			V		S
1793	09	ASPECT			V		S
1793	07	BOUNDARY			V	M	S
1793	08	BOW			V	M	S
1793	10	DEGREE	N			M	
1793	08	DETACHED			V		
1793	10	EDGE			V	M	S
1793	09	FLOW	N	T	V	M	S
1793	07	FORMATION	N		V		S
1793	09	HALF				M	S
1793	10	INCIDENCE	N		V	M	S
1793	07	INDUCED			V	M	S
1793	07	LAYER			V		S
1793	10	LEADING			V	M	S
1793	08	MODEL			V	M	S
1793	07	MOVEMENT	N		V	M	S
1793	09	OIL			V	M	S
1793	09	PATTERN	N	T	V	M	
1793	09	RATIO			V	M	S
1793	08	SEPARATION	N			M	S
1793	07	SHAPE	N		V		S
1793	08	SHOCK			V		
1793	09	STUDY	N		V	M	S
1793	09	SUBSONIC				M	S
1793	09	SUPERSONIC			V	M	S
1793	09	SURFACE			V	M	S
1793	10	SWEEP			V		S
1793	10	SWEPTBACK		T		M	S
1793	10	TAPER				M	
1793	10	TAPERED		T	V	M	S
1793	07	TEST	N		V	M	S
1793	08	TRANSITION	N				S
1793	09	TRANSONIC			V		S
1793	07	TUNNEL			V	M	S
1793	08	VORTEX					S
1793	08	WAVE	N		V		S
1793	07	WIND			V	M	S
1793	09	WING		T	V		S
1794	09	ASPECT			V	M	S
1794	08	BENDING			V	M	
1794	07	BOUNDARY			V		S
1794	07	CENTRE			V		S
1794	09	CHORD			V	M	S
1794	08	CHORDWISE			V	M	S
1794	07	COEFFICIENT	N		V	M	S

1794	10	DEGREE			V	M	
1794	09	DEVELOPMENT	N		V	M	S
1794	09	DISTRIBUTION	N		V	M	S
1794	08	DRAG	N		V	M	S
1794	09	EDGE	N		V		S
1794	09	FLOW	N		V		S
1794	09	FORCE			V	M	S
1794	07	FORWARD			V		S
1794	07	GROWTH	N		V	M	S
1794	09	HALF			V		S
1794	09	INCIDENCE	N		V		S
1794	07	INDUCED			V		S
1794	07	INITIAL				M	S
1794	07	INTERACTION	N		V	M	S
1794	07	LAYER			V	M	S
1794	09	LEADING			V		S
1794	08	LIFT	N		V	M	S
1794	08	LOADING	N		V	M	S
1794	09	MEASUREMENT	N		V	M	
1794	08	MOMENT	N		V	M	
1794	07	NORMAL			V		S
1794	07	OIL			V		S
1794	07	OUTBOARD			V	M	S
1794	07	PATTERN	N		V		S
1794	08	PITCHING			V	M	S
1794	09	PLANFORM		T	V		S
1794	09	PLOTTING	N		V	M	S
1794	09	PRESSURE	N		V		S
1794	08	SEPARATION	N		V	M	S
1794	08	SHOCK					S
1794	07	SPAN			V	M	S
1794	08	SPANWISE					S
1794	09	SUBSONIC			V	M	S
1794	09	SUPERSONIC			V	M	S
1794	09	SURFACE			V	M	S
1794	10	SWEPTBACK		T	V		S
1794	09	TAPER			V	M	S
1794	09	TEST	N		V	M	S
1794	09	THICKNESS			V	M	S
1794	07	TIP			V	M	S
1794	08	TRANSITION	N		V		S
1794	09	TRANSONIC			V	M	S
1794	09	TUNNEL			V	M	S
1794	08	VORTEX			V		S
1794	10	WARREN12		T	V		S
1794	08	WAVE	N		V	M	S
1794	09	WIND			V	M	S
1794	09	WING		T	V	M	S
1795	06	BLOCKAGE			V	M	S
1795	06	BLOWING			V	M	
1795	06	FLOW			V	M	S
1795	06	HALF			V	M	S
1795	08	INTERFERENCE	N		V		S

1795	06	LIFT			V		S	
1795	08	LINERS	N		V	M	S	
1795	06	MACH	N		V	M		
1795	06	MODEL	N		V	M		
1795	06	MODIFIED				M	S	
1795	10	NPL		T	V		S	
1795	06	POWER				M	S	
1795	06	PRESSURE	N		V	M	S	
1795	09	RANGE	N	T	V	M	S	
1795	06	REQUIREMENT	N		V	M	S	
1795	08	SLOTTED			V	M		
1795	06	SPAN			V		S	
1795	09	SPEED		T	V	M		
1795	06	SURVEY	N		V	M	S	
1795	06	SWEPT					S	
1795	06	TEST	N		V		S	
1795	10	TRANSONIC		T	V		S	
1795	10	TUNNEL	N	T	V		S	
1795	08	WALL			V		S	
1795	10	WIND		T				
1795	06	WING	N		V		S	
1796	06	BALLOTINI			V	M	S	
1796	10	BAND	N	T			S	
1796	06	BEAD			V	M	S	
1796	08	BETWEEN				M	S	
1796	09	BOUNDARY		T				
1796	10	CARBORUNDUM	N		V	M	S	
1796	10	CROPPED		T	V			
1796	10	DELTA		T	V	M		
1796	10	DISTRIBUTED		T	V	M		
1796	08	DRAG			V		S	
1796	10	EDGE	N	T			S	
1796	06	GLASS			V			
1796	08	GRAIN	N		V		S	
1796	10	HALF		T	V	M	S	
1796	06	HEXACHLORETHANE	N		V	M	S	
1796	08	INCIDENCE	N		V			
1796	06	INDICATOR	N			M	S	
1796	09	LAYER		T	V		S	
1796	10	LEADING		T				
1796	08	LIFT	N		V	M	S	
1796	08	MACH	N		V		S	
1796	08	MATERIAL	N		V		S	
1796	08	MOMENT	N				S	
1796	10	NEAR			V	M		
1796	08	PARTICLE				M		
1796	08	PENALTY	N		V	M	S	
1796	08	PITCHING					S	
1796	10	ROUGHNESS		T			S	
1796	08	SIZE	N		V	M		
1796	08	SPACING			V	M		
1796	09	SPEED	N	T	V	M		A
1796	06	SUBLIMATION			V			
1796	07	TECHNIQUE	N		V	M	S	
1796	07	TEST	N					
1796	10	TRANSITION	N	T	V	M	S	

1796	09	TRANSONIC		T	V	M	S
1796	07	TUNNEL				M	S
1796	08	WAVE			V		S
1796	08	WIDTH	N		V		S
1796	07	WIND			V	M	S
1796	10	WING	N	T	V	M	S
1797	06	AEROFOIL	N		V		
1797	06	APPEARANCE	N		V	M	S
1797	08	ATTACHMENT	N		V		S
1797	08	BLUNT			V		S
1797	08	BOUNDARY				M	S
1797	08	COEFFICIENT	N		V	M	S
1797	08	COMPONENT	N		V	M	
1797	10	DEGREE		T	V	M	S
1797	08	DEPENDENT			V		S
1797	06	DESIGN	N			M	S
1797	08	DRAG			V		
1797	08	DROOP	N		V	M	S
1797	10	EDGE	N	T	V	M	S
1797	06	ESTIMATION	N		V		S
1797	09	FLOW		T	V	M	
1797	08	FORWARD			V		S
1797	08	HALF			V	M	S
1797	06	INBOARD			V		S
1797	08	INDUCED			V	M	S
1797	06	INITIAL			V	M	S
1797	08	LAYER			V		S
1797	10	LEADING		T	V		
1797	08	LIFT			V		S
1797	06	LOCAL			V	M	S
1797	10	MACH	N		V		S
1797	08	MODEL	N				S
1797	08	NOSED			V	M	S
1797	08	OILFLOW				M	S
1797	06	OUTBOARD			V	M	S
1797	10	PATTERN	N			M	
1797	10	PROFILE	N		V	M	S
1797	08	RADIUS	N		V	M	S
1797	06	REAR				M	S
1797	08	SEPARATION	N				S
1797	08	SHARP			V		S
1797	08	SHOCK				M	S
1797	09	SPEED	N	T	V		SA
1797	06	SURFACE	N		V	M	S
1797	10	SWEPTBACK		T	V	M	S
1797	06	SWEPTFORWARD			V	M	S
1797	09	TEST	N		V		S
1797	06	THREEDIMENSIONAL			V	M	S
1797	06	TIME			V		S
1797	06	TIP			V	M	
1797	10	TRANSONIC		T	V	M	S
1797	09	TUNNEL				M	S
1797	06	TWODIMENSIONAL			V	M	S
1797	10	UNTAPERED			V	M	S
1797	06	UPPER			V		S
1797	06	VORTEX	N		V	M	
1797	08	WAVE	N		V		S

1797	09	WIND			V		S
1797	09	WING	N	T	V	M	S
1798	08	AERODYNAMIC				M	S
1798	07	AEROFOIL	N		V		S
1798	09	BOUNDARY		T	V	M	S
1798	06	BUFFETING	N		V	M	
1798	00	BUZZ	N		V		S
1798	07	CHARACTERISTIC	N		V	M	
1798	07	COEFFICIENT	N		V	M	S
1798	06	COMPRESSION			V	M	
1798	06	CONTROL			V	M	S
1798	05	DISTRIBUTION	N		V		S
1798	08	EDGE	N		V	M	S
1798	05	EFFECT	N	T	V	M	S
1798	08	ENGINE			V	M	S
1798	06	EXPANSION			V	M	S
1798	07	FLAT			V	M	S
1798	07	FLOW	N		V		S
1798	07	FORCE			V		S
1798	07	GENERATED			V	M	S
1798	07	HIGH			V	M	S
1798	06	INCIDENT			V	M	S
1798	07	INDUCED			V	M	S
1798	05	INFLUENCE	N		V		
1798	08	INTAKE	N	T	V		S
1798	10	INTERACTION	N	T	V	M	S
1798	09	LAMINAR			V		S
1798	09	LAYER	N	T	V	M	S
1798	09	MACH	N		V		S
1798	00	MOMENT			V	M	S
1798	07	MOTION			V	M	S
1798	08	OBLIQUE					S
1798	07	PERFORMANCE	N	T	V		S
1798	07	PLATE	N		V	M	S
1798	05	PREDICTION	N		V		S
1798	07	PRESSURE			V		S
1798	08	REATTACHMENT	N		V	M	S
1798	07	RECOVERY				M	S
1798	07	REDUCTION	N		V	M	S
1798	06	REFLECTED			V	M	
1798	09	REYNOLDS	N		V		S
1798	36	SCALE			V		S
1798	05	SECTION			V		S
1798	08	SEPARATION	N		V		
1798	05	SHAPE	N		V		
1798	10	SHOCK		T	V	M	S
1798	05	STATIC			V	M	S
1798	07	STEADY			V		S
1798	09	STRENGTH	N		V	M	
1798	07	SUBSONIC			V	M	S
1798	00	SUPERSONIC		T	V		S
1798	06	SURFACE			V	M	S
1798	05	TEST	N		V		S
1798	08	TRAILING			V	M	S
1798	07	TRANSONIC			V		S

1798	05	TUNNEL			V		S	
1798	09.	TURBULENT			V	M	S	
1798	07	TWODIMENSIONAL			V	M	S	
1798	06	UPSTREAM			V		S	
1798	10	WAVE	N	T	V		S	
1798	07	WEDGE			V	M		
1798	06	WIND			V		S	
1798	07	WING	N		V	M	S	
1799	10	AEROFOIL	N	T	V	M	S	
1799	08	AREA			V	M	S	
1799	08	BLOCKAGE			V		S	
1799	08	BOUNDARY			V	M	S	
1799	08	CHOKING			V		S	
1799	08	CHORD			V		S	
1799	08	CONFIGURATION	N		V		S	
1799	06	CORRECTION	N		V	M	S	
1799	06	DISTORTION			V		S	
1799	10	EFFECT	N	T	V		S	
1799	08	FLOW	N		V	M		
1799	08	HEIGHT	N		V		S	
1799	10	HIGH		T	V	M	S	
1799	08	INCIDENCE	N		V		S	
1799	10	INTERFERENCE		T	V	M	S	
1799	08	LAYER			V		S	
1799	08	LIFT	N			M	S	
1799	06	LOCAL			V		S	
1799	08	MACH	N		V	M		
1799	10	MODEL			V	M	S	
1799	08	OPEN			V	M		
1799	06	PREDICTION	N		V	M	S	
1799	08	RATIO				M	S	
1799	08	REDUCTION				M		
1799	08	SECTION	N					
1799	08	SEPARATED				M	S	
1799	08	SEPARATION	N		V	M		
1799	06	SEVERELY			V	M		
1799	08	SIMULATION	N			M	S	
1799	08	SIZE	N		V	M	S	
1799	08	SLOT			V	M	S	
1799	08	SLOTTED			V	M		
1799	09	SPEED	N	T	V			A
1799	10	SUBSONIC		T		M	S	
1799	06	SUPERSONIC			V	M	S	
1799	09	TEST	N	T	V			
1799	06	THEORETICAL				M	S	
1799	10	TRANSONIC		T		M	S	
1799	10	TUNNEL		T	V		S	
1799	10	TWODIMENSIONAL		T			S	
1799	08	WAKE			V	M	S	
1799	08	WALL	N		V	M	S	
1799	10	WIND		T	V	M	S	
1799	08	WORKING			V		S	
1799	06	ZERO			V			

1800	08	BLOCKAGE			V	M	
1800	10	CYLINDER		T	V		S
1800	08	DISTRIBUTION	N		V	M	
1800	06	DRAG	N				S
1800	08	FIELD			V		
1800	10	HEMISPHERICAL				M	S
1800	06	INCIDENCE	N				
1800	10	INTERFERENCE	N	T			S
1800	10	LONG				M	S
1800	10	MACH	N		V	M	S
1800	08	MODEL	N	T	V	M	S
1800	08	MOVEMENT			V		S
1800	10	NOSE	N		V		S
1800	08	PLOTTING					S
1800	08	POINT			V	M	S
1800	08	POSITION	N		V		S
1800	08	PRESSURE			V	M	S
1800	08	RATE			V	M	S
1800	08	RATIO	N		V	M	S
1800	08	REFLECTION					S
1800	06	SECTION				M	S
1800	08	SHOCK			V	M	S
1800	06	SIZE	N		V	M	S
1800	10	SLOTTED			V		S
1800	08	SONIC			V	M	S
1800	09	SPEED	N	T	V	M	S
1800	08	SURFACE			V	M	S
1800	08	TERMINAL			V	M	S
1800	10	TEST	N		V	M	
1800	10	TRANSONIC		T		M	S
1800	00	TUNNEL			V		
1800	10	WALL	N	T	V	M	S
1800	08	WAVE	N		V		S
1800	10	WIND				M	S
1800	06	WORKING				M	S
1800	06	ZERO			V		S
1836	06	AIRCRAFT					
1836	05	ALLOY	N		V		S
1836	06	ALUMINIUM			V	M	S
1836	09	ANALYSIS	N		V	M	
1836	08	APPROXIMATE				M	
1836	06	AXIAL			V	M	S
1836	08	BENDING			V	M	S
1836	10	BUCKLING	N				S
1836	07	COEFFICIENT				M	S
1836	10	COMPRESSION	N		V	M	S
1836	06	COMPUTER	N		V		S
1836	06	CONCENTRIC				M	S
1836	08	CONTROL			V		S
1836	08	COUPON					
1836	07	DEPENDENT				M	S
1836	10	DISTRIBUTION	N	T	V	M	S
1836	10	ELASTIC			V		S
1836	08	ELASTICITY	N		V	M	S
1836	10	ELEVATED			V		S

1836	08	EXPANSION	N			M	
1836	09	EXPERIMENTAL		T	V	M	S
1836	10	FLAT			V		S
1836	09	GRADIENT	N	T			S
1836	06	INSTRUMENTATION	N		V	M	S
1836	09	INVESTIGATION	N	T			
1836	08	LINEAR					
1836	10	LOAD	N	T	V	M	S
1836	10	LONG		T			S
1836	10	LONGITUDINAL		T	V		S
1836	08	MATERIAL			V	M	S
1836	08	MODULUS					S
1836	10	ONEDIMENSIONAL	N		V		S
1836	10	PLASTIC					S
1836	10	PLATES		T		M	S
1836	08	POSTBUCKLING	N				S
1836	09	RANGE	N			M	
1836	08	ROOM			V		S
1836	10	SIMPLY			V	M	S
1836	07	SOLUTION	N		V	M	S
1836	10	STRESS	N	T	V		S
1836	06	STRUCTURE	N		V		S
1836	10	SUPPORTED	N		V		S
1836	10	TEMPERATURE	N	T		M	
1836	08	TENSION			V		S
1836	10	TEST	N		V	M	S
1836	10	THERMAL			V	M	S
1836	09	TRANSVERSE		T	V	M	S
1836	08	UNIFORM	N		V	M	
1836	07	VALUE	N		V	M	
1874	08	AIR	N		V	M	S
1874	08	COMPRESSED			V	M	S
1874	09	CRITICAL		T	V		
1874	08	ELASTICITY	N		V	M	S
1874	10	FLUTTER		T	V		
1874	08	GRAVITY	N				S
1874	07	INCREASED			V		S
1874	08	LOADING	N		V		S
1874	08	MASS			V		S
1874	10	MODEL		T	V	M	S
1874	09	PREDICTION	N		V		S
1874	07	REDUCTION			V		
1874	09	SPEED	N	T		M	S
1874	09	TEST	N		V	M	
1874	09	TUNNEL	N		V	M	S
1874	09	WIND			V	M	S
1879	08	BOUNDARY	N		V	M	S
1879	08	CONSTRUCTION	N		V	M	S
1879	08	DENSITY				M	S
1879	10	FLUTTER		T	V		
1879	10	MODEL	N	T	V		S
1879	07	RATIO	N		V		

1879	09	SPEED	N	T	V			
1879	08	STIFFNESS			V		S	
1879	07	TEST	N		V	M	S	
1879	09	TESTING	N	T		M	S	
1879	10	TRANSONIC		T		M	S	
1879	09	TUNNEL			V	M	S	
1879	06	VIBRATION			V			
1879	08	WEIGHT			V		S	
1879	09	WIND			V	M		
1880	06	BENDING				M	S	
1880	09	DESIGN	N	T	V		S	
1880	07	FLOW			V	M		
1880	10	FLUTTER		T	V	M	S	
1880	10	MODEL	N	T	V		S	
1880	07	PARAMETER	N		V			A
1880	07	PRECIPITATION	N		V	M	S	
1880	06	RIGIDITY	N		V	M	S	
1880	05	STATIC				M	S	
1880	06	STIFFNESS	N		V	M	S	
1880	09	SUPERSONIC		T	V		S	
1880	08	TEST	N		V		S	
1880	05	TESTING	N	T	V	M	S	
1880	06	TORSIONAL			V	M	S	
1880	06	TORSO			V			
1880	09	TUNNEL			V		S	
1880	07	VARIATION			V	M		
1880	06	VIBRATION			V			
1880	09	WIND			V	M	S	
1916	09	ASPECT		T	V	M	S	
1916	08	ASYMMETRIC			V	M	S	
1916	08	BENDING			V	M	S	
1916	09	BLOW			V		S	
1916	08	DAMPING			V	M	S	
1916	10	DELTA				M		
1916	08	DERIVATIVE	N		V	M	S	
1916	09	DIFFERENTIAL			V	M	S	
1916	08	DYNAMIC			V	M	S	
1916	05	EFFECT	N					
1916	08	ELASTIC			V	M	S	
1916	09	EQUATION	N		V		S	
1916	09	FLOW	N	T	V		S	
1916	09	FOURIER			V	M	S	
1916	10	FREQUENCY	N		V	M		
1916	09	ITERATIVE			V		S	
1916	09	LINEAR			V		S	
1916	08	MODE	N		V			
1916	10	NONSTEADY			V	M	S	
1916	10	OSCILLATING		T	V	M	S	
1916	08	OSCILLATION	N		V	M	S	
1916	09	PARTIAL			V	M	S	
1916	09	PERTURBATION				M	S	

1916	08	PITCH	N		V		S
1916	08	PITCHING			V	M	S
1916	08	PLUNGING				M	S
1916	09	POTENTIAL	N		V	M	S
1916	09	RATIO	N	T	V	M	
1916	09	REDUCED			V	M	S
1916	09	REDUCTION			V		S
1916	08	RIGID			V	M	S
1916	08	ROLLING			V	M	S
1916	09	SOLUTION	N		V	M	S
1916	00	STABILITY					S
1916	06	THICKNESS				M	S
1916	09	THREEDIMENSIONAL			V		S
1916	08	TORSIONAL			V		S
1916	09	TRANSFORMATION	N		V		S
1916	10	TRANSONIC		T	V	M	S
1916	10	WING	N	T	V	M	
1919	09	AERODYNAMIC			V	M	S
1919	09	ASPECT		T	V	M	
1919	09	ASYMPTOTIC					S
1919	09	BLOW			V	M	S
1919	09	CALCULATION	N		V	M	
1919	08	CHORDWISE			V	M	S
1919	07	COEFFICIENT	N		V	M	S
1919	08	DAMPING					S
1919	08	DISTRIBUTION	N		V	M	S
1919	09	EXPANSION			V	M	S
1919	09	FLOW	N	T	V	M	S
1919	10	FORCE	N		V		
1919	08	LIFT			V		
1919	08	MOMENT			V	M	
1919	10	OSCILLATING		T	V		S
1919	08	PITCH	N		V	M	
1919	08	PITCHING					S
1919	09	POTENTIAL			V		S
1919	08	PRESSURE			V		
1919	09	RATIO	N	T	V	M	S
1919	10	RECTANGULAR		T	V	M	S
1919	09	SERIES	N			M	S
1919	08	SLENDER			V	M	S
1919	08	SPANWISE					S
1919	07	THEORY	N		V	M	S
1919	07	TOTAL			V	M	S
1919	08	TRANSLATION	N		V		S
1919	10	TRANSONIC		T	V	M	S
1919	10	UNSTEADY		T	V		S
1919	09	VELOCITY				M	
1919	10	WING	N	T	V	M	S
1920	09	APPROXIMATION	N		V		S
1920	09	ASPECT		T	V	M	S
1920	09	ASYMPTOTIC			V		
1920	09	DISTRIBUTION	N		V	M	S
1920	09	FLOW	N	T		M	

1920	10	INCLINED		T	V	M	S
1920	10	LAMINAR			V	M	S
1920	10	LIFT			V	M	
1920	09	LINEARIZED			V	M	
1920	09	LONG				M	S
1920	09	NARROW			V		S
1920	09	POTENTIAL				M	
1920	09	RATIO	N	T	V	M	S
1920	09	SOLUTION	N				S
1920	09	SUPERSONIC		T	V		S
1920	09	THEORY			V	M	
1920	10	WING	N	T	V	M	S
1920	09	ZERO		T	V		
1921	10	BODY	N	T	V	M	S
1921	07	CALCULATION	N		V		S
1921	08	CHORDWISE			V		S
1921	08	DELTA			V	M	S
1921	07	DESIGN	N		V		S
1921	07	DETERMINATION	N		V		S
1921	08	DISTRIBUTION	N		V	M	S
1921	07	DRAG	N		V		S
1921	06	EXPANSION			V	M	S
1921	07	EXTENSION	N	T		M	S
1921	08	FLAT			V	M	
1921	07	FLOW	N		V	M	S
1921	08	FORCE			V		S
1921	08	INCIDENCE	N		V		
1921	08	LIFT			V	M	S
1921	05	LINEARIZED			V	M	S
1921	05	METHOD	N		V	M	S
1921	07	MINIMUM			V		S
1921	08	NOTSOSLENDER			V	M	S
1921	08	PLATE			V		S
1921	08	POINTED			V		S
1921	06	POTENTIAL			V	M	S
1921	08	PRESSURE			V		S
1921	06	SINK			V	M	S
1921	10	SLENDER		T	V	M	S
1921	08	SLOPE	N			M	S
1921	06	SOURCE					S
1921	07	SUBSONIC			V	M	
1921	07	SUPERSONIC				M	S
1921	10	THEORY	N	T	V	M	S
1921	08	THREEDIMENSIONAL			V		S
1921	08	UNSTEADY			V	M	S
1921	06	VELOCITY			V	M	S
1921	06	VONKARMAN			V	M	
1921	08	WARD			V	M	S
1921	10	WING	N		V	M	S
1963	06	BETWEEN				M	S
1963	08	BIOT	N			M	S
1963	08	CHANNEL			V	M	S

1963	10	CONVECTION		T	V	M	S
1963	08	DISTRIBUTION					S
1963	10	EQUATION	N		V		
1963	06	EXPANSION			V	M	S
1963	08	FLOW	N		V		S
1963	08	FLUID				M	
1963	00	FURCED			V		S
1963	06	FUNCTION			V	M	S
1963	10	HEAT	N	T	V	M	
1963	06	LARGE			V	M	S
1963	06	METHCD	N		V	M	S
1963	06	NUMBER	N			M	
1963	06	ORTHOGONAL			V	M	S
1963	08	PARABOLIC			V		S
1963	08	PARALLEL			V		S
1963	06	PECLET			V		S
1963	08	PLATE	N		V	M	S
1963	10	PRINCIPLE	N	T	V	M	S
1963	08	SEMIINFINITE				M	S
1963	08	SLUG				M	S
1963	08	STEADY			V		S
1963	08	TEMPERATURE			V		S
1963	10	TRANSFER	N		V	M	S
1963	08	TRANSIENT			V	M	S
1963	08	TWO			V	M	S
1963	10	VARIATION			V	M	S
1963	10	VARIATIONAL		T	V	M	S
1964	08	BOUNDARY			V	M	S
1964	10	COEFFICIENT	N	T			S
1964	06	CONTRACTING			V	M	S
1964	06	CONTRACTION			V		S
1964	08	CONVERGING			V	M	S
1964	06	DATA	N		V		S
1964	06	DESIGN	N		V	M	S
1964	06	DIAMETER			V		
1964	10	DISCHARGE		T		M	
1964	10	ENTRANCE		T	V	M	S
1964	10	ENTRY			V		S
1964	06	EQUIVALENT			V	M	S
1964	06	EXPERIMENTAL			V	M	
1964	08	FLOW	N		V	M	S
1964	10	FLOWMETER	N	T		M	S
1964	06	FRICTIONAL			V		S
1964	08	LAYER			V		S
1964	06	LENGTH			V	M	S
1964	08	NOZZLE	N		V	M	S
1964	08	NUMBER	N		V		S
1964	08	POTENTIAL					
1964	06	PRESSURE			V	M	S
1964	06	RATIO			V	M	
1964	06	REYNOLDS			V	M	S
1964	10	RUUNDED			V	M	S
1964	06	SECTION	N			M	S
1964	06	SHAPE	N		V	M	S
1964	06	TAP	N		V	M	S
1964	09	THEORY	N	T			S

1964	06	TOTAL			V		
1964	10	VENTURIS	N	T			S
1965	09	ANALYTIC		T		M	S
1965	06	APPROXIMATE			V		
1965	08	BOUNDARY			V	M	S
1965	10	COEFFICIENT	N	T	V		S
1965	06	DATA	N		V		S
1965	09	DETERMINATION	N	T	V	M	S
1965	08	DIAMETER	N		V	M	S
1965	10	DISCHARGE		T	V		
1965	08	EFFECT	N		V	M	S
1965	06	EQUATION	N		V		S
1965	00	EXPERIMENTAL			V	M	S
1965	09	FLOW		T	V		S
1965	09	FLUID			V		S
1965	08	FRICTION			V	M	
1965	08	FUNCTION	N		V		S
1965	08	GEOMETRY	N		V	M	S
1965	06	INTEGRATION	N		V	M	S
1965	08	LAYER	N				S
1965	09	MEASUREMENT	N			M	S
1965	06	MOMENTUM			V	M	S
1965	10	NOZZLE	N	T	V	M	S
1965	07	NUMBER	N		V	M	S
1965	06	PROFILE			V	M	S
1965	10	RATE			V		S
1965	08	RATIO			V		
1965	06	SOLUTION	N		V		S
1965	08	THICKNESS			V	M	
1965	06	THROAT				M	
1965	09	THROUGH			V		S
1965	06	VELOCITY			V		S
1966	08	BODY		T	V	M	S
1966	07	BOUNDARY	N			M	
1966	07	BUOYANCY	N		V	M	
1966	10	CHANNEL	N	T	V		
1966	10	COMPRESSIBILITY	N	T	V	M	S
1966	08	CONVECTION	N		V	M	S
1966	06	COUETTE			V	M	S
1966	09	DEVELOPED		T	V	M	
1966	08	FIXED			V	M	
1966	09	FLOW	N	T	V		S
1966	07	FLUID			V	M	
1966	08	FORCE	N	T	V	M	S
1966	08	FRICTIONAL			V	M	S
1966	09	FULLY		T	V	M	S
1966	07	GAS			V		S
1966	07	GRADIENT	N		V	M	S
1966	06	GRAVITY	N		V		
1966	08	HEATING	N		V		S
1966	09	LAMINAR					S
1966	06	PAST			V		S
1966	06	POISEUILLE			V		S
1966	07	PRESSURE			V	M	S
1966	07	PROPERTY	N	T	V		S

1966	08	STREAMWISE			V	M	S
1966	07	TEMPERATURE			V	M	
1966	07	VARIABLE		T	V		S
1966	07	VARIATION			V		S
1966	08	WALL			V	M	
1967	10	ACCELERATED		T	V		S
1967	06	AUGMENTATION	N		V	M	S
1967	10	AXIAL			V	M	
1967	10	BODY		T		M	S
1967	10	CIRCULAR				M	S
1967	09	COMPRESSIBLE		T	V	M	S
1967	10	CONDUCTING				M	
1967	07	DEVELOPED					S
1967	07	DIFFERENCE	N		V	M	S
1967	10	ELECTRIC			V		S
1967	10	ELECTRICALLY			V	M	S
1967	06	ELECTROMAGNETICALLY			V		S
1967	08	ENTRY			V		S
1967	06	EXHAUST	N		V	M	
1967	10	FIELD					S
1967	09	FLOW	N	T	V	M	S
1967	09	FLUID	N		V	M	S
1967	10	FORCE	N	T	V	M	S
1967	07	FULLY				M	S
1967	10	GAS	N			M	
1967	00	GRADIENT	N				S
1967	06	HARTMANN			V	M	
1967	05	HIGH			V	M	S
1967	05	INDUCED				M	S
1967	06	IONIZED			V		
1967	09	LAMINAR		T	V		S
1967	07	LENGTH	N		V	M	S
1967	10	MAGNETIC			V	M	S
1967	10	MAGNETOFLUIDMECHANICS	N		V	M	
1967	05	NUMBER	N			M	
1967	10	PIPE	N	T	V		S
1967	07	PRESSURE			V	M	S
1967	07	PROFILE	N		V	M	S
1967	06	ROCKET			V	M	S
1967	06	SEEDED			V		S
1967	09	STEADY			V		S
1967	07	TEMPERATURE	N		V	M	S
1967	09	THEORY	N			M	S
1967	06	THRUST					S
1967	07	VELOCITY	N				S
1967	10	VISCOUS		T	V		S
1967	07	WALL					S
1968	08	ACCELERATION			V		
1968	05	APPROACH	N		V		S
1968	08	ARC			V		S
1968	06	BOOST	N		V	M	S
1968	05	CAPABILITY	N		V	M	S
1968	06	CAPTURE			V		S
1968	05	CHANGE			V		S
1968	07	CHARACTERISTIC	N		V	M	
1968	08	CHEMICAL			V	M	S

1968	05	CONTROL	N		V	M	S
1968	05	CORRECTION	N		V	M	S
1968	06	DECAY	N		V		S
1968	05	DESIGN			V	M	S
1968	05	DURATION			V		S
1968	06	EARTH			V	M	S
1968	05	EFFICIENCY	N		V		S
1968	08	ELECTRICAL			V	M	S
1968	07	ENERGY			V		S
1968	08	ENGINE			V		S
1968	08	ENVIRONMENTAL			V	M	
1968	06	EQUILIBRIUM	N		V	M	S
1968	06	ESCAPE			V	M	S
1968	05	FIELD	N		V		
1968	06	FISSION	N		V	M	S
1968	05	FLEXIBILITY	N		V	M	S
1968	10	FLIGHT	N	T	V	M	S
1968	06	FUSION	N		V	M	S
1968	06	GRAVITY	N		V	M	S
1968	05	GROWTH			V		S
1968	08	HEATING			V		S
1968	05	HIGH			V	M	S
1968	06	IMPULSE	N			M	S
1968	10	INTERJECTORY			V	M	S
1968	10	INTERPLANETARY		T	V		S
1968	08	ION			V	M	S
1968	06	ISOTOPE					S
1968	08	LIGHT			V	M	S
1968	08	LIQUID			V	M	S
1968	08	MAGNETOPLASMA			V	M	S
1968	06	MANOEUVRE	N		V		S
1968	05	MASS				M	S
1968	06	METEORITE	N		V	M	S
1968	06	METEROID	N		V		S
1968	09	MIDCOURSE			V		S
1968	07	MISSION	N		V	M	S
1968	07	MULTIPLE			V		S
1968	08	NUCLEAR			V		S
1968	06	ORBIT			V		S
1968	05	ORIENTATION	N		V	M	S
1968	07	PERFORMANCE	N		V	M	S
1968	05	PLANE	N		V	M	S
1968	06	PLANET			V		S
1968	06	POWER	N			M	S
1968	08	PROPELLANTS			V	M	S
1968	10	PROPULSION	N	T	V	M	S
1968	06	RADIATION	N		V	M	S
1968	06	RADIOACTIVE			V		S
1968	09	RATIO	N		V		S
1968	05	RELATION			V	M	S
1968	08	RELIABILITY	N		V	M	S
1968	07	REQUIREMENT	N		V		S
1968	06	RESTART			V		S
1968	08	REYNOLDS			V	M	S
1968	10	ROCKET	N	T	V	M	S

1968	08	SAIL			V	M	S
1968	08	SOLAR			V		S
1968	08	SOLID			V	M	S
1968	07	SOURCE			V		S
1968	06	SPECIFIC			V		S
1968	09	SYSTEM	N	T	V	M	S
1968	06	TARGET			V	M	S
1968	06	THERMAL			V		S
1968	06	THRUST	N				S
1968	10	TRAJECTORY	N		V	M	S
1968	09	TRANSFER	N		V	M	S
1968	06	VACUUM			V	M	S
1968	05	VECTOR			V		S
1968	08	VEHICLE			V		S
1968	06	VELOCITY			V		S
1968	05	VOLUME	N		V	M	
1968	08	WAVE					S
1968	06	WEIGHT	N		V	M	S
1968	05	ZERO			V		S
1970	10	AIR		T	V		
1970	07	CENTRE					
1970	08	CHORDWISE				M	S
1970	06	CONTROL	N			M	S
1970	10	EXHAUSTING		T	V	M	
1970	10	FLAT		T		M	S
1970	09	FLOW	N	T	V		S
1970	06	FORCE	N			M	S
1970	09	FREE		T	V		S
1970	10	INDUCED		T	V	M	
1970	08	INTERFERENCE			V	M	S
1970	10	JET		T	V		S
1970	10	LOAD	N	T	V	M	S
1970	07	LOCATION	N		V		
1970	09	MACH	N	T		M	
1970	09	MEASUREMENT	N		V		S
1970	06	MOMENT	N		V	M	
1970	09	NORMAL		T	V	M	S
1970	08	NOZZLE			V	M	
1970	09	PERPENDICULARLY		T	V	M	
1970	10	PLATE		T	V		
1970	07	PRESSURE	N		V	M	
1970	07	RATIO			V	M	
1970	06	REACTION			V	M	S
1970	07	STATIC			V	M	
1970	09	STREAM		T	V	M	S
1970	09	SUBSONIC				M	S
1970	09	SUPERSONIC			V		S
1970	08	THRUST	N		V	M	S
1970	07	TOTAL					S
1970	05	TYPE			V		
1970	10	WING	N	T	V	M	S
1971	09	ADJACENT		T	V	M	S
1971	06	ALTITUDE			V	M	S
1971	10	ARROW				M	S
1971	05	AUGMENTATION	N				S

1971	10	BLUNT				M	S
1971	06	CONTROL	N		V	M	S
1971	09	DISTRIBUTION	N	T	V		
1971	09	EDGE	N		V	M	
1971	09	EFFECT	N		V	M	S
1971	10	EXITING			V	M	S
1971	10	FLAT		T			S
1971	09	FLOW	N		V	M	
1971	09	HYPERSONIC					S
1971	10	INTERFERENCE					S
1971	10	JET	N	T		M	S
1971	09	LEADING			V	M	S
1971	05	LOSS	N		V		S
1971	08	MACH		T	V		
1971	09	NORMAL		T		M	S
1971	10	NOSE			V	M	
1971	10	NOZZLE			V	M	S
1971	07	NUMBER	N		V		S
1971	10	PLATE			V		S
1971	0	PRESSURE		T	V	M	S
1971	09	RATIO	N		V	M	
1971	06	REACTION			V	M	
1971	10	REENTRY			V		S
1971	08	REYNOLDS			V	M	S
1971	09	SHARP			V		S
1971	09	SONIC		T		M	
1971	09	SUPERSONIC				M	S
1971	09	SURFACE	N	T		M	S
1971	06	THRUST			V		
1971	10	VEHICLE	N		V		S
1971	10	WING	N			M	S
1972	09	AERODYNAMIC		T	V	M	S
1972	07	BOUNDARY			V	M	
1972	08	CHORDWISE			V		
1972	06	CONTROL	N		V	M	S
1972	07	DISTRIBUTION			V	M	S
1972	09	EFFECT		T		M	S
1972	10	EXHAUSTING		T	V	M	
1972	10	FLAT		T	V	M	S
1972	09	FLOW	N		V	M	S
1972	08	FORCE	N		V		
1972	09	FREE		T	V	M	
1972	09	HYPERSONIC			V		S
1972	10	INTERACTION		T	V	M	S
1972	10	JET	N	T	V		S
1972	07	LAYER			V		S
1972	09	MACH		T	V	M	S
1972	09	MODEL	N		V	M	S
1972	00	NORMAL			V		
1972	09	PERPENDICULARLY		T	V	M	
1972	10	PLATE		T		M	S
1972	07	PRESSURE	N			M	S
1972	07	RATIO	N		V	M	S
1972	08	REACTION			V		S
1972	08	SEPARATION	N			M	S

1972	08	SLOT			V	M	S
1972	10	SONIC		T	V	M	
1972	06	SPACE				M	S
1972	08	STAGNATION			V	M	
1972	07	STATIC			V	M	
1972	09	STREAM	N	T	V		S
1972	07	SURFACE				M	
1972	09	TEST	N		V	M	
1972	08	TRANSITIONAL			V		S
1972	09	TUNNEL			V	M	S
1972	07	TURBULENT			V	M	S
1972	10	TWODIMENSIONAL			V		S
1972	06	VEHICLE	N		V		S
1972	08	WIDTH	N		V		S
1972	09	WIND				M	S
1973	07	ANGLE			V	M	S
1973	07	ATTACK	N		V		S
1973	09	BALANCE			V		S
1973	10	BASE	N	T	V	M	S
1973	07	BODY			V		S
1973	07	BOUNDARY			V	M	
1973	06	CONTROL	N				S
1973	10	CYLINDER		T	V		S
1973	07	DIAMETER				M	S
1973	06	DRAG	N			M	S
1973	09	EFFECT	N	T	V	M	
1973	10	EXHAUSTING		T	V	M	S
1973	09	FLOW	N		V	M	
1973	07	FORCE	N		V	M	
1973	07	FOREBODY			V		
1973	07	FREE			V		S
1973	10	INTERACTION		T	V		S
1973	10	JET		T	V		S
1973	07	LAMINAR			V		S
1973	10	LATERALLY		T	V	M	
1973	07	LAYER	N		V	M	S
1973	07	LENGTH	N		V	M	S
1973	07	MACH			V	M	S
1973	09	MAIN		T		M	S
1973	09	MEASUREMENT	N		V	M	S
1973	09	MODEL	N	T	V	M	
1973	06	NUMBER	N		V		S
1973	10	OGIVE		T	V	M	S
1973	07	PRESSURE					S
1973	07	RATIO	N			M	
1973	06	REACTION			V	M	
1973	06	SEPARATION	N		V		S
1973	10	SIDE					
1973	08	STAGNATION			V	M	S
1973	09	STING			V	M	
1973	09	STREAM		T	V	M	S
1973	09	SUPERSONIC		T	V		S
1973	09	TEST	N		V	M	S
1973	09	TUNNEL				M	S
1973	07	TURBULENT			V	M	

1973	09	WIND			V	M	S
1974	06	ACCOMODATION			V		S
1974	05	ADDITION	N		V	M	S
1974	05	ANALYSIS	N	T		M	
1974	07	BOUNDARY			V	M	S
1974	07	CALCULATION	N				S
1974	06	CONICAL					S
1974	10	CONTROL	N	T	V		
1974	08	EVAPORATING			V		S
1974	06	EXOTHERMIC			V	M	S
1974	07	EXPERIMENTAL			V		S
1974	07	EXTENT	N		V		S
1974	05	FACTOR	N		V	M	S
1974	10	FLUID		T	V	M	S
1974	08	FORCE	N		V		S
1974	08	GAS	N				S
1974	05	HEAT			V	M	S
1974	06	HEIGHT			V	M	S
1974	06	IMPULSE	N		V	M	S
1974	06	INJECTED			V	M	S
1974	10	INJECTION	N	T	V	M	S
1974	00	INTERACTION	N			M	S
1974	07	LAYER			V		
1974	08	LIQUID			V	M	
1974	06	MAGNIFICATION			V		S
1974	09	MAIN			V	M	
1974	07	MEASUREMENT	N		V		S
1974	06	MOLECULAR			V	M	S
1974	10	NOZZLE	N			M	S
1974	07	PRESSURE	N		V	M	S
1974	06	PRIMARY			V	M	S
1974	00	RATE			V	M	S
1974	05	RATIO	N		V		S
1974	06	REACTION			V	M	S
1974	07	REGION	N		V	M	S
1974	10	ROCKET			V		S
1974	08	SEPARATED			V	M	S
1974	00	SEPARATION	N		V	M	S
1974	08	SHOCK			V	M	S
1974	06	SIDE			V		S
1974	05	SMALL			V	M	S
1974	05	SPECIFIC			V		
1974	09	STREAM	N		V	M	S
1974	09	SUPERSONIC			V		S
1974	10	THRUST		T	V	M	S
1974	07	TURBULENT			V		S
1974	10	VECTOR		T	V		S
1974	08	WAVE			V	M	S
1974	06	WEIGHT	N			M	S
1978	8	ABLATION	N		V	M	S
1978	06	BLUNT			V	M	S
1978	08	BODY	N		V	M	S
1978	09	BOUNDARY	N	T	V		S
1978	08	COMBUSTION					S
1978	07	CONDITION	N		V		

1978	10	CONDUCTION			V		S
1978	10	CONDUCTIVITY	N		V	M	S
1978	06	CONVECTIVE			V	M	S
1978	10	CYLINDER			V		S
1978	09	EQUATION	N		V		
1978	08	EROSION	N			M	S
1978	07	EXTERNAL			V	M	S
1978	09	FINITE		T	V	M	S
1978	07	FLOW			V	M	S
1978	06	FLUX			V		
1978	08	GRAPHITE			V	M	S
1978	09	HEAT			V	M	S
1978	08	HEATING	N		V		S
1978	05	HISTORY	N		V	M	S
1978	06	HYPERSONIC			V		S
1978	07	MATERIAL	N		V	M	
1978	07	MOTION	N		V	M	S
1978	09	MOVING		T	V		S
1978	06	NOSED			V	M	S
1978	09	NUMERICAL			V	M	S
1978	05	POINT	N		V		S
1978	09	PROFILE	N	T	V		
1978	07	RATE	N			M	S
1978	08	REENTRY			V		S
1978	07	REMOVAL			V	M	S
1978	09	SOLID	N	T	V		S
1978	09	SOLUTION	N		V		S
1978	06	STAGNATION			V	M	S
1978	08	SUBLIMATION			V	M	S
1978	08	SURFACE	N		V	M	S
1978	09	TEMPERATURE	N	T	V	M	S
1978	09	THICKNESS	N		V		S
1978	05	TRANSFER			V	M	S
1978	09	TRANSIENT			V		S
1978	09	VARIABLE			V		S
1978	08	VEHICLE			V	M	
1978	07	WALL			V		S
1980	09	ADIABATIC		T	V	M	
1980	09	ARBITRARY		T	V		S
1980	07	AVERAGE			V	M	S
1980	09	COEFFICIENT	N	T		M	S
1980	09	COMPUTATION	N		V		S
1980	10	CONVECTION			V	M	S
1980	06	COPPER			V	M	S
1980	07	FLOW	N		V	M	S
1980	09	FORCED				M	
1980	09	HEAT		T	V		
1980	10	HEATING	N		V		S
1980	09	HISTORY	N		V		
1980	09	HOMOGENEOUS			V	M	S
1980	06	INCONEL			V	M	S
1980	07	SERIES	N		V	M	S
1980	10	SURFACE			V	M	S
1980	10	TEMPERATURE	N	T			S
1980	10	THERMALLY				M	

1980	10	THICK		T	V		
1980	08	THIN			V	M	
1980	07	TIME			V	M	
1980	09	TRANSFER		T		M	S
1980	10	TRANSIENT		T		M	S
1980	07	TRIANGLE			V	M	
1980	07	UNIT			V	M	S
1980	09	VARIATION		T		M	S
1980	10	WALL	N	T			
1981	08	AERODYNAMIC			V	M	S
1981	06	BLUNT			V	M	S
1981	10	BODY			V	M	S
1981	09	BOUNDARY		T	V		S
1981	05	CALCULATION	N			M	S
1981	09	CONDITION	N	T	V		S
1981	08	CONDUCTION		T	V		
1981	06	CONE	N		V		S
1981	09	CONSTANT			V		S
1981	09	DEPENDENT		T	V	M	
1981	09	DISTRIBUTION	N		V	M	
1981	07	EQUATION	N	T	V	M	S
1981	09	FLOW	N				
1981	10	HEAT		T		M	S
1981	08	HEATING	N		V		S
1981	09	MATERIAL			V	M	
1981	06	NOSE			V	M	S
1981	10	ONEDIMENSIONAL			V	M	S
1981	06	POINT					S
1981	09	PROPERTY	N		V		S
1981	10	SLAB	N				
1981	10	SOLID			V	M	S
1981	09	SOLUTION	N	T		M	
1981	06	STAGNATION			V	M	S
1981	10	TEMPERATURE				M	S
1981	09	THEORETICAL			V	M	S
1981	06	THIN			V	M	S
1981	09	TIME		T	V		S
1981	10	TRANSIENT			V	M	S
1981	06	WING	N		V	M	
1982	10	AERODYNAMIC			V		S
1982	10	ATMOSPHERE	N	T	V	M	S
1982	07	BACK			V		S
1982	07	BOUNDARY			V	M	S
1982	09	CALCULATION	N				S
1982	08	CONDUCTION	N			M	
1982	06	COPPER				M	S
1982	07	DISTRIBUTION	N				S
1982	10	EARTH			V		S
1982	10	ENTERING			V	M	S
1982	07	FINITE			V		S
1982	07	FUNCTION					S
1982	07	GENERALIZED			V	M	S
1982	06	GRAPHITE			V	M	S

1982	07	GREEN				M	S
1982	10	HEAT			V	M	S
1982	10	HEATING	N	T		M	S
1982	09	HISTORY		T	V	M	S
1982	10	HYPERSONIC			V		
1982	07	INTEGRATION			V	M	S
1982	10	LAMINAR		T	V		S
1982	07	LAYER			V	M	S
1982	07	MATERIAL			V	M	S
1982	07	MAXIMUM			V		S
1982	06	MOLYBDENUM			V	M	S
1982	07	ONEDIMENSIONAL			V	M	S
1982	09	OUTER			V	M	S
1982	05	PERFORMANCE	N				S
1982	09	PROFILE	N			M	
1982	07	PROPERTY	N		V	M	S
1982	08	RADIATION	N				S
1982	07	RATE	N		V	M	S
1982	10	REENTRY			V	M	
1982	10	SINK	N		V	M	S
1982	10	SKIN		T	V		S
1982	07	SOLUTION	N		V	M	S
1983	10	BODY					S
1983	10	EARTH				M	
1983	08	ENTHALPY	N		V		S
1983	08	EXPERIMENT	N		V	M	S
1983	08	FLIGHT			V	M	S
1983	09	HEAT		T			S
1983	08	HYPERSONIC			V	M	S
1983	07	MEASUREMENT	N			M	
1983	10	POINT					S
1983	07	PRESSURE	N		V	M	S
1983	09	RATE	N			M	S
1983	10	REENTRY					S
1983	10	REVOLUTION					S
1983	10	SATELLITE		T		M	S
1983	09	SHOCK			V		S
1983	07	SOLUTION	N		V	M	S
1983	10	STAGNATION			V	M	S
1983	07	THEORETICAL					
1983	09	TRANSFER		T	V		
1983	09	TUBE			V	M	S
1983	10	VEHICLE	N	T	V	M	S
1983	08	VELOCITY	N		V	M	S
1984	09	ANALYSIS	N	T	V		S
1984	08	BLADE			V		S
1984	10	CENTRIFUGAL		T		M	
1984	06	CHOKED				M	S
1984	10	COMPRESSIBLE		T	V	M	S
1984	10	COMPRESSOR	N		V	M	S
1984	08	CURVATURE	N		V	M	S
1984	07	DISTRIBUTION	N		V	M	S
1984	09	FLOW	N	T	V		S
1984	08	FORCE	N			M	S

1984	07	GRADIENT	N		V	M	S
1984	10	HUB			V	M	
1984	10	IMPELLER		T	V	M	S
1984	10	INLET	N		V	M	
1984	10	ISENTROPIC					
1984	07	MAXIMUM			V		S
1984	09	MERIDIONAL				M	S
1984	10	MIXED		T	V		
1984	08	PLANE	N		V		S
1984	07	PRESSURE	N		V		S
1984	07	PROFILE	N			M	S
1984	08	ROTATIONAL			V		S
1984	06	SEPARATION	N		V		S
1984	07	SEVERE					S
1984	10	SHROUD	N		V		S
1984	08	STREAMLINE	N		V	M	S
1984	07	SURFACE	N			M	S
1984	08	TANGENTIAL			V	M	S
1984	09	THEORETICAL			V		S
1984	08	VELOCITY			V		
1984	07	WEIGHT					S
1985	08	ANGLE	N		V	M	S
1985	10	BLADE	N	T	V	M	
1985	07	CARRYING					S
1985	10	CENTRIFUGAL		T	V	M	
1985	10	COMPRESSIBLE			V		S
1985	10	COMPRESSOR	N		V	M	S
1985	09	DESIGN	N	T	V	M	
1985	07	DISTRIBUTION	N		V	M	S
1985	06	EXIT			V	M	S
1985	09	FILAMENT					S
1985	09	FLOW	N			M	
1985	08	FORCE			V	M	S
1985	07	GRADIENT	N				
1985	10	HUB	N	T	V		S
1985	10	IMPELLER	N	T			S
1985	08	INLET			V		S
1985	10	ISENTROPIC			V		S
1985	07	MAXIMUM			V		SA
1985	08	MERIDIONAL			V	M	S
1985	08	MIXED			V	M	S
1985	10	NONVISCOUS			V		S
1985	07	OVERALL			V	M	S
1985	08	PARABOLIC			V	M	S
1985	08	PLANE				M	S
1985	07	PRESCRIBED			V	M	S
1985	07	PRESSURE				M	S
1985	09	PROFILE	N	T	V		S
1985	05	RELATIVE			V		S
1985	10	SHAPE	N	T		M	S
1985	08	SHAPED			V		S
1985	10	SHROUD		T	V		

1985	06	SLIP	N		V	M	S
1985	08	SPACING	N			M	S
1985	09	STREAM			V	M	
1985	08	STREAMLINE			V	M	S
1985	08	STREAMTUBE			V		S
1982	08	SURFACE					
1982	10	TEMPERATURE					
1982	09	THICK					
1982	08	THICKNESS					
1982	08	TRAJECTORY					
1982	08	WALL					
1982	06	TUNGSTEN			V		
1982	10	VEHICLE	N		V	M	S
1983	10	BLUNT			V	M	S
1983	10	ATMOSPHERE	N	T	V		S
1983	08	ALTITUDE	N		V	M	
1985	09	THEORY	N			M	
1985	08	TANGENTIAL			V	M	S
1985	08	VELOCITY	N		V	M	S
1985	08	WEIGHT			V	M	S
1986	08	DECELERATION			V		S
1986	09	DESIGN	N	T	V	M	S
1986	08	ADIABATIC			V		S
1986	08	BLADE					S
1986	10	BLADING	N			M	S
1986	10	DIFFUSER	N		V	M	S
1986	10	BRADING	N		V	M	S
1986	10	CENTRIFUGAL			V		S
1986	10	CIRCULAR			V		
1986	10	COMPRESSOR	N			M	S
1986	08	DRIVING			V		S
1986	08	EDDY				M	S
1986	07	EFFICIENCY	N		V		S
1986	07	ELIMINATION			V	M	S
1986	08	FACE	N		V		
1986	09	FLOW	N	T		M	S
1986	07	FORMATION			V	M	S
1986	09	GRADIENT					
1986	10	HUB	N			M	S
1986	10	IMPELLER		T		M	S
1986	09	IMPROVED			V	M	S
1986	10	INLET			V	M	S
1986	10	ISENTROPIC				M	S
1986	07	MAXIMUM			V	M	S
1986	10	MIXED		T	V	M	
1986	07	OPERATION			V	M	S
1986	10	OUTLET	N		V	M	S
1986	10	PARABOLIC					S
1986	08	PEAK			V	M	S
1986	08	POTENTIAL					S
1986	00	PRESSURE			V		S
1986	07	RANGE	N		V	M	S

1986	07	RATIO	N		V	M	S
1986	09	REDUCTION				M	S
1986	08	RISE				M	S
1986	06	ROTATING			V	M	
1986	06	SEPARATION	N			M	S
1986	10	SHROUD		T	V	M	S
1986	10	SKEWED			V	M	S
1986	06	STALL	N		V		S
1986	06	SURGE	N			M	S
1986	08	TEMPERATURE			V	M	S
1986	10	VANELESS				M	S
1986	10	VELOCITY			V		S
1986	08	WEIGHT					S
1986	07	WIDE			V	M	S
1987	07	ABSOLUTE					
1987	08	AEROTHERMODYNAMIC			V	M	S
1987	10	AXIAL		T	V	M	
1987	07	BASIC			V	M	
1987	08	BLADE			V	M	
1987	10	COMPRESSOR			V	M	S
1987	07	EQUATION	N		V	M	S
1987	09	FLOW	N	T	V	M	S
1987	09	FLUID	N		V	M	
1987	08	INLET					S
1987	08	IRROTATIONAL			V	M	S
1987	10	MIXED		T	V		S
1987	10	NONVISCOUS					S
1987	07	POTENTIAL				M	S
1987	10	RADIAL		T	V	M	S
1987	07	RELATION	N		V	M	S
1987	09	RELATIVE			V	M	S
1987	08	ROTATING			V	M	S
1987	08	ROTATIONAL			V		S
1987	08	ROW	N		V		
1987	09	SOLUTION	N		V	M	S
1987	09	STEADY			V	M	S
1987	09	STREAM			V	M	
1987	09	SUBSONIC		T	V	M	S
1987	09	SUPERSONIC		T		M	S
1987	09	SURFACE	N		V		S
1987	09	THEORETICAL				M	
1987	10	THREEDIMENSIONAL		T	V	M	S
1987	10	TURBOMACHINE		T		M	S
1987	09	TWODIMENSIONAL			V	M	S
1988	09	ANALYSIS	N				S
1988	06	ANGLE	N		V	M	S
1988	08	ATTACK	N		V	M	
1988	10	AXIAL			V	M	S
1988	10	BLADE		T			S
1988	07	CALCULATION	N		V	M	S
1988	07	CONDITION	N		V	M	S
1988	07	DISTRIBUTION	N		V	M	S

1988	08	DRIVING			V	M	
1988	08	EDDY			V		S
1988	08	EDGE			V	M	S
1988	08	FACE	N		V		S
1988	07	FACTOR	N		V	M	S
1988	09	FLOW	N	T		M	S
1988	07	FUNCTION	N		V		
1988	06	HEAD					S
1988	10	IMPELLER		T	V	M	
1988	09	INCOMPRESSIBLE				M	S
1988	10	INLET			V		S
1988	07	LARGE				M	S
1988	08	LOCATION			V		S
1988	05	MAXIMUM					S
1988	10	MIXED			V	M	S
1988	10	NONVISCOUS		T	V	M	S
1988	06	OUTLET			V	M	S
1988	05	PARAMETER	N		V	M	S
1988	08	POINT	N		V	M	S
1988	07	POSITIVE			V		S
1988	08	POTENTIAL			V	M	S
1988	08	PRESSURE			V	M	S
1988	08	PREWHIRL	N		V	M	S
1988	10	PROPELLANTS			V	M	S
1988	10	PUMP		T	V	M	S
1988	05	RATIO			V		S
1988	08	REAR					S
1988	05	RELATIVE			V	M	S
1988	09	REVOLUTION	N	T		M	S
1988	06	RISE			V	M	S
1988	10	ROCKET			V		
1988	10	ROTOR	N		V		S
1988	08	SLIP			V		S
1988	08	STAGNATION			V	M	
1988	08	STREAM			V		S
1988	09	SURFACE		T	V	M	
1988	08	TRAILING				M	S
1988	06	UPSTREAM			V	M	S
1988	08	VELOCITY	N		V	M	S
1989	09	ADJACENT			V		
1989	09	ANALYSIS	N		V	M	S
1989	08	ANGLE			V	M	
1989	08	ATTACK	N		V		S
1989	10	BLADE	N		V		S
1989	07	DISTRIBUTION	N		V	M	S
1989	07	DIVISION					S
1989	06	DRIVING			V		S
1989	06	EDDY			V	M	
1989	08	EDGE			V	M	S
1989	06	FACE			V		S
1989	07	FACTOR	N		V		S
1989	09	FLOW	N	T	V	M	S
1989	05	FORMATION			V	M	S
1989	06	HEAD			V		
1989	10	IMPELLER	N		V	M	S
1989	09	INCOMPRESSIBLE		T	V		S

1989	08	INLET			V	M	S
1989	08	LOADING					S
1989	08	LOCATION			V	M	S
1989	09	MAIN			V	M	S
1989	10	MIXED			V	M	S
1989	10	NONVISCOUS		T	V	M	
1989	08	POINT	N		V	M	S
1989	08	PREWHIRL	N		V	M	S
1989	10	PUMP		T	V	M	S
1989	08	REAR			V	M	S
1989	09	REVOLUTION	N		V	M	S
1989	06	RISE	N		V		S
1989	08	ROTATIONAL			V	M	S
1989	10	ROTOR		T	V		
1989	08	SLIP			V		S
1989	08	SPEED	N		V		S
1989	10	SPLITTER	N	T	V	M	S
1989	08	STAGNATION			V		
1989	09	SURFACE	N		V	M	S
1989	09	THEORETICAL			V	M	S
1989	08	TIP	N		V	M	S
1989	08	TRAILING				M	S
1989	08	UPSTREAM				M	S
1989	10	VANE		T			S
1989	07	VARIATION	N		V	M	S
1989	08	VELOCITY	N			M	S
1989	08	WEIGHT					S
1989	08	WHIRL	N				S
1990	09	ARBITRARY			V		S
1990	10	BLADE	N	T	V	M	S
1990	09	CALCULATION	N		V		S
1990	10	CENTRIFUGAL		T		M	S
1990	09	COMPRESSIBLE				M	
1990	10	COMPRESSOR	N	T		M	
1990	09	CONTOUR	N		V		
1990	08	CURVATURE	N		V		S
1990	09	DISTRIBUTION	N	T	V		S
1990	09	FLOW	N		V		S
1990	09	HUB			V		S
1990	10	IMPELLER		T	V		S
1990	09	INCOMPRESSIBLE			V		S
1990	07	METHOD	N	T		M	S
1990	10	MIXED				M	
1990	10	NONVISCOUS			V		
1990	07	NUMBER			V	M	S
1990	10	RADIAL			V		
1990	07	RATE	N		V	M	S
1990	07	RELAXATION				M	S
1990	09	SHAPE	N		V	M	S
1990	09	SHROUD					S
1990	08	SPEED	N		V	M	
1990	10	SURFACE	N				S
1990	09	THEORETICAL			V	M	S
1990	08	TIP	N			M	S
1990	10	TWODIMENSIONAL			V	M	S
1990	10	VELOCITY		T		M	S

1991	10	AIR		T	V		S
1991	10	BODY				M	
1991	07	DISTRIBUTION	N		V		S
1991	10	DRAG	N	T	V		S
1991	09	ENERGY			V		S
1991	06	EXIT	N		V	M	
1991	09	FLOW	N	T		M	S
1991	05	FREE			V		S
1991	09	HIGH			V		
1991	10	JET	N	T	V		
1991	06	MIXING					S
1991	09	MODEL	N			M	S
1991	10	NOSE	N	T	V	M	S
1991	05	NUMBER	N		V		S
1991	09	PRESSURE		T	V	M	
1991	05	PROCESS			V		S
1991	10	PROJECTION			V	M	
1991	10	PROLATE		T	V	M	
1991	09	REDUCTION	N	T	V	M	S
1991	05	RELATIVE			V		
1991	06	REYNOLDS				M	S
1991	08	SHADOWGRAPH				M	S
1991	06	SHEAR			V	M	S
1991	06	SIZE	N		V		S
1991	06	SLOPE	N		V	M	
1991	10	SPHEROID		T	V	M	S
1991	05	STREAM	N		V		S
1991	09	STUDY	N	T		M	S
1991	05	SUPERSONIC			V	M	S
1991	05	TEST	N		V	M	S
1991	08	THRUST	N		V	M	
1991	10	TRANSONIC		T			S
1991	05	TUNNEL				M	S
1991	05	WIND			V	M	
1991	10	WING		T			
1992	10	AIR		T	V	M	S
1992	10	BODY		T	V	M	S
1992	07	BOUNDARY				M	S
1992	07	COEFFICIENT	N				S
1992	05	DISTRIBUTION	N		V	M	S
1992	08	DRAG	N		V	M	S
1992	10	ELLIPTICAL			V	M	S
1992	10	EXHAUSTING		T	V	M	
1992	09	FLOW		T	V	M	S
1992	08	FOREBODY			V	M	S
1992	10	FORWARD			V	M	
1992	08	FRICTION			V	M	S
1992	10	JET		T	V		S
1992	07	LAYER			V		S
1992	09	MACH	N		V		S
1992	10	NOSE		T			S
1992	07	NUMBER	N				S
1992	05	PATTERN	N			M	S
1992	05	PHENOMENA	N			M	S
1992	06	PHOTOGRAPH	N		V	M	S

1992	09	POINT	N		V	M	S
1992	07	PRESSURE			V		
1992	10	REVOLUTION	N	T	V		S
1992	08	REYNOLDS			V	M	S
1992	06	SCAVENGING			V	M	
1992	06	SCHLIEREN			V	M	
1992	08	SKIN			V	M	S
1992	09	SMALL		T	V		S
1992	09	STAGNATION			V	M	S
1992	09	SUPERSONIC		T	V	M	S
1992	05	SURFACE			V		S
1992	09	TEST	N		V		
1992	08	THRUST			V	M	S
1992	07	TOTAL				M	
1992	08	TRANSITION	N		V	M	S
1992	09	TUNNEL			V	M	S
1992	08	VISCOUS			V	M	
1992	09	WIND					
1993	10	AFTERBODY	N	T	V	M	S
1993	07	ANGLE		T	V		S
1993	07	ATTACK	N	T	V	M	S
1993	08	BASE			V		S
1993	08	BODY			V	M	S
1993	06	BOW			V	M	S
1993	10	CYLINDRICAL		T	V	M	S
1993	06	DETACHMENT				M	S
1993	07	DIAMETER	N		V		S
1993	06	DISTANCE	N		V	M	S
1993	07	DISTRIBUTION	N		V	M	S
1993	10	EXHAUSTING			V	M	
1993	08	EXIT			V	M	S
1993	07	FIELD	N		V	M	S
1993	09	FLOW			V		S
1993	09	FREE			V	M	S
1993	08	INTERFERENCE			V	M	S
1993	10	JET		T		M	S
1993	08	LEEWARD					
1993	09	MACH	N		V	M	S
1993	10	NOZZLE		T	V		S
1993	07	NUMBER	N				
1993	08	PHOTOGRAPH	N		V		
1993	07	PRESSURE	N		V		S
1993	07	RATIO				M	S
1993	08	REYNOLDS			V	M	S
1993	08	SCHLIEREN			V	M	
1993	08	SHOCK			V		
1993	00	SONIC		T	V		
1993	07	STATIC			V	M	S
1993	09	STREAM	N	T	V		S
1993	07	STRUCTURE	N		V	M	S
1993	09	SUPERSONIC		T	V	M	S
1993	09	TEST	N		V	M	S
1993	07	TOTAL			V	M	
1993	09	TUNNEL			V	M	
1993	08	WAVE			V	M	S
1993	09	WIND			V	M	S

1993	08	WINDWARD			V		S
1994	08	AFTERBODY			V		S
1994	10	BLUNT		T	V	M	S
1994	10	BODY	N	T	V	M	S
1994	06	DECELERATION	N		V	M	S
1994	09	DISTRIBUTION	N			M	S
1994	10	DRAG	N		V		S
1994	10	EXHAUSTING		T	V		
1994	07	FIELD	N				S
1994	09	FLOW	N			M	S
1994	08	FOREBODY			V		
1994	09	FREE		T	V	M	S
1994	10	JET			V	M	S
1994	09	LONGITUDINAL				M	S
1994	07	MACH			V	M	S
1994	09	NOSE		T	V	M	S
1994	06	NUMBER	N			M	S
1994	09	PRESSURE			V	M	
1994	09	RADIAL				M	
1994	08	RESULTANT			V		S
1994	10	RETROROCKET	N	T	V		S
1994	09	SEGMENT			V		S
1994	06	SPACE					S
1994	10	SPHERICAL			V	M	
1994	08	STABILITY	N		V	M	S
1994	09	STREAM	N	T	V	M	S
1994	09	SUPERSONIC		T			
1994	09	TEST	N		V	M	S
1994	10	THRUST	N		V		
1994	09	TUNNEL			V		S
1994	06	VEHICLE	N		V	M	S
1994	09	WIND			V		
1995	09	AERODYNAMIC		T	V		S
1995	10	AIR				M	
1995	07	ATTACK	N		V	M	S
1995	08	AXIAL			V	M	
1995	10	BODY		T	V	M	S
1995	08	BOW			V	M	S
1995	09	CHARACTERISTIC	N	T	V	M	S
1995	07	COEFFICIENT	N		V	M	S
1995	08	COLD			V		S
1995	08	CONVERGING			V	M	S
1995	10	COUNTERCURRENT			V		S
1995	08	DECELERATION				M	
1995	07	DISTANCE	N		V		S
1995	07	DISTRIBUTION	N		V		S
1995	08	DIVERGING				M	S
1995	08	DRAG	N		V		S
1995	10	EXHAUSTING			V	M	S
1995	08	EXPANSION			V	M	S
1995	09	FACE	N		V	M	S
1995	09	FLOW	N		V		S

1995	08	FORCE	N		V	M	S
1995	10	FORWARD			V		S
1995	07	FREE			V	M	S
1995	08	INTERFERENCE			V		S
1995	08	JET			V	M	
1995	07	MACH		T	V		S
1995	08	MOMENT	N		V		S
1995	08	NOZZLE	N				S
1995	08	NUMBER	N	T	V	M	S
1995	07	PHENOMENA	N			M	S
1995	08	PITCHING			V	M	S
1995	07	PRESSURE	N		V	M	S
1995	10	RETROROCKET		T	V		S
1995	10	REVOLUTION	N	T		M	
1995	10	SEMIELLIPSOID			V		S
1995	08	SHOCK			V	M	
1995	10	SIMULATED		T	V	M	S
1995	08	STANDOFF				M	
1995	10	STREAM	N		V		S
1995	09	SUBSONIC			V		S
1995	09	SUPERSONIC			V	M	
1995	09	TEST	N		V	M	S
1995	07	TOTAL				M	S
1995	09	TUNNEL				M	S
1995	08	WAVE					S
1995	09	WIND.			V	M	S
1997	10	AIR	N		V		S
1997	08	ANGLE	N		V	M	S
1997	10	AXISYMMETRIC		T	V	M	S
1997	08	BASE			V		S
1997	06	BOATTAIL			V		S
1997	08	BOUNDARY	N		V	M	S
1997	07	CALCULATION	N		V	M	S
1997	06	CHARACTERISTIC	N		V		S
1997	08	CONICALLY			V	M	
1997	00	CURVATURE	N		V	M	S
1997	08	DIVERGENCE			V	M	S
1997	08	DIVERGENT			V	M	S
1997	08	DOWNSTREAM			V	M	S
1997	08	EFFECT	N		V		S
1997	07	EVALUATION	N		V		S
1997	10	EXHAUSTING			V	M	S
1997	08	EXIT	N			M	S
1997	08	EXPERIMENT	N		V	M	S
1997	08	FAR			V	M	S
1997	10	FREE		T	V		S
1997	08	HEAT			V	M	S
1997	08	HYPERSONIC			V		S
1997	08	INCLINATION			V		S
1997	08	INITIAL				M	S
1997	06	INTERFACE			V		S
1997	08	INTERFERENCE			V		
1997	10	JET	N	T	V		S
1997	06	JOHANNESEN			V		S
1997	06	LOCATION			V		S
97	10	MACH			V	M	S

1997	06	METHOD	N		V		S
1997	06	MEYER				M	S
1997	06	MIXING				M	S
1997	06	NOISE	N		V		S
1997	08	NOZZLE	N		V	M	S
1997	09	NUMBER	N		V	M	S
1997	06	PHOTOGRAPH	N		V	M	S
1997	08	PRESSURE	N		V		
1997	08	RATIO	N			M	S
1997	06	REFLECTION			V	M	S
1997	06	RIEMANN			V	M	S
1997	06	SCHLIEREN			V		S
1997	08	SHAPE	N		V	M	S
1997	08	SHOCK	N		V		S
1997	06	SIMULATION	N		V		S
1997	08	SONIC			V	M	S
1997	08	SPECIFIC					S
1997	08	STATIC			V	M	S
1997	10	STILL			V	M	S
1997	10	STREAM	N		V		S
1997	08	STRUCTURE	N			M	S
1997	08	SUPERSONIC			V		S
1997	08	SURFACE			V		S
1997	09	THEORY	N				S
1997	08	VEHICLE	N		V		S
1997	06	WAVE	N		V	M	S
1997	08	WAVELENGTH	N		V	M	S
1997	06	WITHIN			V		S
2001	08	AFTERBODY	N		V	M	S
2001	10	ANGLE		T	V	M	S
2001	06	APPARATUS	N		V	M	S
2001	04	ATMOSPHERE	N		V	M	S
2001	08	ATTACK			V	M	
2001	08	AXIAL			V		S
2001	08	BASE	N			M	S
2001	10	BLUNTED		T	V	M	
2001	10	CHARACTERISTIC	N	T	V		S
2001	10	CONE	N	T	V		S
2001	04	CONFIGURATION	N		V	M	S
2001	08	CONICAL				M	S
2001	08	DAMPING			V	M	S
2001	10	DEGREE	N	T	V	M	S
2001	06	DESIGN	N		V		S
2001	06	DESTABILIZING			V		S
2001	10	DYNAMIC		T		M	
2001	06	EFFECT	N		V	M	
2001	04	ENTRY			V		
2001	08	FLAT			V	M	S
2001	08	FORCE	N		V		S
2001	09	INVESTIGATION	N	T	V		S
2001	08	MACH	N		V		
2001	06	MODEL	N		V	M	S
2001	00	MODIFIED			V	M	S
2001	08	MOMENT	N		V	M	
2001	08	NORMAL				M	S
2001	04	PHASE			V	M	S
2001	08	PITCHING				M	S

2001	04	PLANETARY			V	M	S
2001	08	PRESSURE	N		V		S
2001	04	PROBE			V	M	S
2001	08	RANGE			V		
2001	08	SEGMENT					
2001	10	SEMIVERTEX		T	V		S
2001	08	SPHERICAL					S
2001	10	STABILITY		T	V	M	S
2001	10	STATIC		T	V	M	
2001	04	TERMINAL			V	M	
2001	08	TRUNCATED				M	S
2001	09	TUNNEL		T			
2001	04	VEHICLE			V		S
2001	09	WIND		T	V	M	S
2002	08	AXISYMMETRIC				M	S
2002	10	BLUNT			V	M	
2002	10	BODY	N	T	V	M	S
2002	09	DISTRIBUTION	N		V	M	S
2002	08	DRAG	N		V		S
2002	08	FACED			V		S
2002	08	FLAT			V	M	
2002	09	FLOW			V		S
2002	08	FORM			V	M	S
2002	09	HEAT			V	M	S
2002	08	HEMISPHERICALLY			V		S
2002	09	HYPERSONIC		T	V	M	S
2002	09	LENGTH	N			M	S
2002	09	MACH	N		V		S
2002	09	MEASUREMENT	N		V	M	S
2002	08	NOSED			V		
2002	09	PRESSURE			V	M	S
2002	08	SEPARATION	N		V	M	S
2002	10	SPIKE				M	S
2002	10	SPIKED		T			S
2002	09	TRANSFER	N		V	M	S
2002	09	TUNNEL			V		S
2002	09	WIND			V	M	S
2061	10	ACTIVE			V		
2061	09	AMBIENT			V	M	
2061	08	CHEMICAL		T		M	
2061	10	CHEMICALLY				M	S
2061	08	CONCENTRATION			V	M	S
2061	07	CONTINUITY	N			M	S
2061	07	DIMENSIONLESS			V	M	S
2061	07	ENERGY			V	M	S
2061	09	EQUATION	N		V		S
2061	10	EXHAUST		T	V		
2061	07	FORM	N			M	
2061	10	GAS	N		V	M	SA
2061	07	HEAT			V	M	S

2061	10	ISSUING			V		S
2061	10	JET	N	T		M	
2061	07	MASS			V		S
2061	10	MIXING		T	V	M	
2061	07	MOMENTUM			V		S
2061	07	NET			V	M	S
2061	07	PRODUCTION			V	M	S
2061	07	PROFILE	N		V	M	S
2061	07	RATE					S
2061	10	REACTING					S
2061	08	REACTION	N	T	V	M	S
2061	07	RELEASE			V		S
2061	10	ROCKET		T	V	M	
2061	07	SPECIES	N		V		S
2061	07	STATE	N			M	S
2061	09	STREAM	N	T	V	M	S
2061	09	SUPERSONIC		T		M	S
2061	07	TEMPERATURE			V	M	S
2061	10	TURBULENT		T	V	M	S
2061	10	TWODIMENSIONAL				M	
2061	08	VELOCITY				M	S
2074	10	ABOVE	N		V	M	S
2074	08	ANGLE	N		V	M	S
2074	09	APPROXIMATE			V		S
2074	10	BODY		T	V	M	
2074	09	CALCULATION	N		V	M	S
2074	10	COMBINATION					S
2074	08	CONE	N				S
2074	08	CURVATURE			V	M	S
2074	08	CYLINDER			V	M	S
2074	08	DISTRIBUTION	N		V	M	
2074	08	EDGE			V		
2074	06	EXPANSION			V	M	S
2074	09	EXPERIMENT	N		V	M	S
2074	08	FIELD	N		V	M	S
2074	09	FLOW	N		V		S
2074	06	GENERALIZED			V		S
2074	10	INTERFERENCE	N	T	V		S
2074	06	INTERSECTING			V	M	
2074	08	LEADING			V	M	S
2074	06	LOCAL			V		S
2074	10	MACH	N		V		S
2074	06	METHOD	N		V	M	S
2074	08	NONLIFTING			V	M	S
2074	06	PERPENDICULAR					S
2074	08	PRESSURE			V	M	S
2074	10	SECONDORDER		T	V	M	S
2074	06	SHOCK			V		S
2074	08	SMALL			V	M	S
2074	09	SOLUTION	N		V	M	S
2074	08	SPANWISE					S
2074	09	SUPERSONIC		T	V	M	S
2074	08	SWEEP			V	M	S
2074	06	TANGENT			V	M	
2074	09	TUNNEL				M	S
2074	06	TWO				M	S
2074	06	TWODIMENSIONAL					S

2074	06	WEDGE			V	M	S
2074	09	WIND			V	M	S
2074	10	WING	N	T	V	M	S
2075	08	ANGLE			V	M	S
2075	10	BODY	N	T	V		S
2075	09	CALCULATION	N		V		S
2075	08	COMBINATION	N		V	M	S
2075	10	DEGREE	N				
2075	10	DISTRIBUTION	N			M	
2075	09	EXPERIMENT	N				
2075	06	FIELD					
2075	09	FLOW	N		V		S
2075	06	GRADIENT	N		V		S
2075	10	INCIDENCE		T	V	M	S
2075	10	INTERFERENCE	N	T	V	M	S
2075	08	MACH	N			M	S
2075	10	NONLIFTING		T	V	M	S
2075	10	ORDER		T		M	S
2075	10	PRESSURE				M	
2075	00	RANGE			V	M	S
2075	10	SECOND		T			S
2075	09	SUPERSONIC			V	M	S
2075	08	SWEEPBACK	N				
2075	09	THEORETICAL		T	V		S
2075	09	THEORY	N		V		S
2075	07	TUNNEL			V	M	
2075	07	WIND			V		
2075	10	WING	N	T			S
2076	09	APPROXIMATE		T	V		
2076	08	ARC				M	
2076	09	BOUNDARY		T	V		S
2076	09	CALCULATION	N		V	M	
2076	08	CIRCULAR			V	M	
2076	09	COMPRESSIBLE			V		S
2076	08	CURVED			V	M	
2076	08	DISPLACEMENT		T	V	M	S
2076	08	DISTRIBUTION	N				S
2076	08	DRAG	N	T	V	M	S
2076	08	FLAT			V	M	S
2076	09	FLOW	N	T	V		S
2076	08	FRICTION			V	M	S
2076	09	HYPERSONIC		T	V	M	S
2076	10	INSULATED			V		S
2076	09	LAMINAR		T	V	M	
2076	09	LAYER	N	T	V	M	
2076	09	LINEAR			V	M	S
2076	08	MACH	N		V	M	S
2076	08	MOMENTUM				M	S
2076	08	PLATE	N		V		S
2076	08	PRESSURE			V	M	S
2076	08	PROFILE	N		V	M	S
2076	08	SKIN			V		S

2076	10	SURFACE	N		V	M	S
2076	07	TEST			V	M	S
2076	08	THICKNESS	N		V	M	S
2076	07	TUNNEL			V		
2076	10	TWODIMENSIONAL		T	V		
2076	09	VELOCITY			V	M	S
2076	08	VISCOUS		T	V	M	S
2076	07	WIND			V	M	
2077	08	ANGLE		T	V	M	S
2077	00	ARDC			V	M	
2077	08	ATMOSPHERE	N	T	V	M	
2077	10	ATTACHED		T	V	M	
2077	08	ATTACK		T		M	S
2077	07	CONTROL					S
2077	08	DEGREE	N		V	M	S
2077	08	DIHEDRAL		T	V		S
2077	08	EDGE			V	M	
2077	08	EFFECTIVE			V	M	
2077	08	EQUILIBRIUM		T	V	M	S
2077	08	GAS	N	T	V	M	S
2077	08	HEAT			V		S
2077	08	INFINITE			V		S
2077	08	LEADING			V	M	
2077	07	LIFTING			V	M	
2077	08	MACH	N			M	
2077	09	METHOD		T			S
2077	08	MODEL			V	M	S
2077	10	OBLIQUE		T	V		
2077	08	PARAMETER	N		V	M	SA
2077	08	RANGE			V	M	
2077	08	RATIO			V	M	
2077	08	REAL		T	V	M	S
2077	10	RESULT	N	T	V	M	S
2077	08	SHARP					S
2077	10	SHOCK		T	V	M	
2077	09	SOLUTION	N	T		M	
2077	08	SPECIFIC			V	M	
2077	07	SURFACE	N	T	V	M	
2077	08	SWEEP		T	V		S
2077	10	SYSTEM	N	T		M	
2077	10	TABLE			V		S
2077	10	WAVE		T	V	M	
2077	08	WING	N		V		S
2078	08	ATTACHED			V		S
2078	10	CIRCULAR		T	V		S
2078	06	COEFFICIENT				M	S
2078	06	CONTOUR	N			M	S
2078	10	CYLINDER	N	T	V	M	S
2078	06	DISTRIBUTION			V	M	S
2078	08	DOWNSTREAM			V		S
2078	06	DRAG				M	
2078	09	EQUATION	N		V		S

2078	10	FLOW	N	T	V	M	
2078	10	FLUID	N	T	V	M	
2078	10	INCOMPRESSIBLE				M	S
2078	08	LENGTH			V	M	S
2078	10	NAVIERSTOKES			V	M	S
2078	09	NUMERICAL			V	M	
2078	08	PAIR			V		
2078	08	PORTION			V	M	S
2078	06	PRESSURE			V	M	S
2078	10	REYNOLDS	N	T		M	S
2078	09	SOLUTION	N				
2078	08	STATIONARY				M	S
2078	10	STEADY		T	V	M	S
2078	06	SURFACE	N		V	M	S
2078	06	VELOCITY			V	M	S
2078	10	VISCOUS		T			S
2078	08	VORTEX			V	M	
2078	06	VORTICITY					S
2078	06	WAKE	N		V		S
2080	06	BOUNDARY			V	M	
2080	09	CALCULATION	N		V	M	S
2080	08	CIRCULATING			V	M	S
2080	08	COEFFICIENT	N			M	S
2080	08	COORDINATE	N				S
2080	08	DEVELOPMENT				M	S
2080	08	DIFFERENCE				M	
2080	08	DISTRIBUTION	N		V	M	S
2080	08	DRAG			V		S
2080	08	FINITE			V	M	S
2080	10	FLOW	N	T	V		S
2080	08	FORWARD			V	M	S
2080	08	FUNCTION	N			M	S
2080	06	LAYER	N		V	M	S
2080	10	LOW		T	V	M	S
2080	10	METHOD	N				S
2080	08	MODIFIED			V		S
2080	10	NUMBER	N	T	V		S
2080	08	POLAR			V	M	S
2080	08	PRESSURE			V		S
2080	10	RELAXATION					S
2080	10	REYNOLDS		T	V		S
2080	08	SEPARATION			V	M	
2080	10	SPHERE	N	T	V	M	S
2080	08	SPHERICAL			V		
2080	08	STREAM			V		S
2080	06	SYMMETRICAL			V	M	S
2080	06	TRANSITION			V	M	
2080	00	VELOCITY			V	M	S
2080	10	VISCOUS		T	V	M	S
2080	08	VORTICITY				M	S
2080	08	WAKE	N		V	M	
2081	07	BOUNDARY			V		S

2081	10	CIRCULAR		T	V			
2081	07	COEFFICIENT	N		V	M	S	
2081	07	CONDITION	N		V			
2081	10	CYLINDER	N	T	V			
2081	07	DATA	N		V		S	
2081	07	DIFFERENCE			V		S	
2081	08	DISCONTINUOUS			V	M	S	
2081	07	DISTRIBUTION	N				S	
2081	08	DRAG			V		S	
2081	09	EQUATION	N	T	V			
2081	07	EXPERIMENTAL			V	M	S	
2081	07	FINITE			V	M	S	
2081	09	FLOW	N	T	V	M	S	
2081	09	FLUID	N		V	M	S	
2081	09	INTEGRATING			V	M	S	
2081	08	KIRSCHHOFF			V	M	S	
2081	07	MOTION	N		V		S	
2081	09	NAVIER		T	V	M		
2081	09	NUMERICAL		T	V	M	S	
2081	08	PATTERN	N		V	M		
2081	07	PRESSURE					S	
2081	07	REDUCTION			V	M		
2081	09	REYNOLDS	N	T	V	M	S	
2081	09	SOLUTION	N	T	V	M	S	
2081	09	STEADY			V	M	S	
2081	09	STOKES		T			S	
2081	07	THEORY	N			M		
2081	10	TWODIMENSIONAL			V	M	S	
2081	08	VELOCITY			V	M		
2081	10	VISCOUS			V		S	
2081	08	VORTICITY			V	M	S	
2082	07	APPROXIMATION	N		V	M	S	
2082	10	AXISYMMETRIC		T	V	M		
2082	10	BLUNT			V	M	S	
2082	07	BOUNDARY			V			
2082	09	COEFFICIENT	N			M		
2082	07	CONDITION	N			M		A
2082	07	COORDINATE	N		V	M	S	
2082	07	CYLINDRICAL			V	M	S	
2082	05	DIFFERENCE	N			M	S	
2082	09	EQUATION	N	T	V	M		
2082	07	FINITE					S	
2082	09	FLOW	N	T	V	M	S	
2082	07	FUNCTION					S	
2082	09	INCOMPRESSIBLE				M		
2082	09	LOW		T	V			
2082	10	NAVIERSTOKES		T		M	S	
2082	10	NOSED			V	M	S	
2082	10	NUMBER	N	T				
2082	09	NUMERICAL		T	V		S	
2082	08	ORIFICE		T	V	M	S	
2082	10	PIVO			V	M		
2082	06	POINT			V		S	
2082	09	PRESSURE	N		V	M	S	
2082	10	REYNOLDS		T	V			
2082	08	SIZE	N	T	V			

2082	09	SOLUTION	N	T	V	M	S
2082	06	STAGNATION			V	M	
2082	09	STEADY		T	V		
2082	08	STOKES			V	M	S
2082	08	STREAM			V		
2082	06	STREAMLINE	N				S
2082	10	TUBE	N	T	V	M	S
2082	07	VARIABLE	N		V		S
2082	05	VARIATION	N		V		
2082	06	VELOCITY			V	M	S
2082	10	VISCOSITY	N	T			S
2082	10	VISCOUS		T	V		S
2082	08	VORTICITY			V	M	S
2083	08	AIR			V	M	S
2083	05	BOUNDARY			V	M	S
2083	08	CHANNEL			V		S
2083	08	CIRCULAR			V		S
2083	05	CONDITION	N		V	M	SA
2083	08	CURRENT	N		V		S
2083	08	CYLINDER	N		V	M	S
2083	07	DETERMINATION	N		V	M	S
2083	07	DISTRIBUTION	N		V		S
2083	06	DRAG	N		V	M	S
2083	07	EXPERIMENTAL			V		S
2083	09	FLOW	N	T	V	M	S
2083	06	FLUID	N	T			S
2083	06	FRICTION			V	M	S
2083	05	GIVEN			V	M	S
2083	05	NORMAL			V		S
2083	07	NUMBER	N		V		S
2083	09	NUMERICAL			V	M	S
2083	08	PARALLEL			V	M	S
2083	06	PERFECT			V	M	S
2083	07	PRESSURE			V		S
2083	07	REYNOLDS			V	M	S
2083	06	SKIN			V		S
2083	09	SOLUTION	N		V	M	S
2083	05	SPEED	N				S
2083	07	STATIONARY			V		S
2083	09	STEADY			V	M	S
2083	06	STREAMLINE	N		V	M	S
2083	06	SURFACE			V		S
2083	05	TOTAL			V	M	S
2083	10	TWODIMENSIONAL			V	M	S
2083	06	UNWIND			V		S
2083	10	VISCOUS			V	M	
2083	06	VORTICITY	N		V	M	
2083	08	WALL	N		V	M	S
2084	09	APPROXIMATION	N		V	M	S
2084	06	CHANNEL			V		S
2084	10	CIRCULAR		T	V		S
2084	07	COEFFICIENT	N			M	S

2084	10	CYLINDER	N	T	V		S
2084	07	DISTRIBUTION	N		V	M	S
2084	08	DRAG	N		V		S
2084	08	EDDY			V		S
2084	07	EXPERIMENT	N		V		S
2084	08	FILAMENT				M	S
2084	09	FLOW	N	T		M	
2084	07	FREQUENCY	N		V		S
2084	00	FRICTION			V		
2084	05	FUNCTION	N		V	M	S
2084	06	KARMAN			V		S
2084	07	LINE	N		V		S
2084	09	LOW		T	V	M	S
2084	08	NUMBER	N		V	M	S
2084	09	NUMERICAL			V		S
2084	07	OIL			V	M	S
2084	08	OSCILLATING			V	M	
2084	07	PHOTOGRAPHIC			V	M	S
2084	07	PRESSURE			V		S
2084	07	REGION	N		V	M	S
2084	08	REYNOLDS			V	M	
2084	08	SEPARATION	N		V	M	S
2084	08	SKIN			V		S
2084	09	SOLUTION	N		V		S
2084	09	SPEED		T	V	M	
2084	09	STEADY			V	M	S
2084	06	STREAM			V	M	S
2084	08	STREAMLINE	N		V		S
2084	06	STREET	N		V	M	S
2084	07	STUDY			V	M	S
2084	09	SUCCESSIVE			V		S
2084	07	TOTAL			V	M	S
2084	10	VISCOUS			V		S
2084	08	VORTICITY	N		V	M	S
2084	06	WALL	N		V		S
2084	07	WATER			V	M	S
2085	10	CONVERGENCE	N	T		M	S
2085	09	EQUATION	N	T	V	M	S
2085	09	FLOW	N		V	M	
2085	07	LOCAL					S
2085	08	MESH			V		S
2085	10	NAVIERSTOKES		T			
2085	09	NUMERICAL		T	V		S
2085	08	REYNOLDS	N		V		
2085	09	SOLUTION	N	T	V	M	
2085	09	STEADY			V	M	
2085	10	TWODIMENSIONAL			V	M	S
2087	05	APPROXIMATION	N		V		S
2087	08	BOUNDARY			V	M	
2087	10	CONVERGENCE		T		M	S
2087	10	DIFFERENTIAL		T	V		S
2087	06	EIGENVALVE			V		S

2087	10	EQUATION	N	T	V	M	S
2087	05	EXTRAPOLATED			V	M	S
2087	10	ITERATIVE		T			S
2087	06	LIEBMAN			V	M	S
2087	07	METHOD	N			M	S
2087	09	NUMERICAL			V	M	S
2087	10	PARTIAL		T		M	S
2087	05	PROBLEM	N		V		
2087	09	RATE	N	T	V	M	
2087	08	RELAXATION			V	M	S
2087	06	RICHARDSON			V	M	
2087	05	SECONDORDER			V		
2087	09	SOLUTION	N		V	M	
2087	05	SUCCESSIVE				M	S
2088	07	APPROXIMATION	N				S
2088	10	BOUNDARY					S
2088	08	CONVERGENCE			V	M	
2088	09	DIFFERENCE	N	T	V	M	
2088	10	DIFFERENTIAL			V	M	
2088	10	ELLIPTIC		T	V		
2088	10	EQUATION	N	T		M	S
2088	09	FINITE			V	M	S
2088	10	ITERATIVE		T	V	M	S
2088	06	LIEBMAN			V		
2088	07	METHOD	N	T		M	S
2088	09	NUMERICAL			V	M	
2088	08	OVERRELAXATION					S
2088	10	PARTIAL		T		M	S
2088	09	PROBLEM	N		V	M	S
2088	07	RATE	N		V	M	S
2088	06	RICHARDSON			V		S
2088	09	SOLUTION			V	M	S
2088	07	SUCCESSIVE				M	S
2088	10	VALUE			V	M	S
2099	10	ABLATION	N	T	V	M	
2099	10	ANALYSIS	N				S
2099	06	BLUNT			V	M	S
2099	06	BODY	N				S
2099	06	BOUNDARY			V	M	S
2099	08	CAPACITY	N			M	
2099	06	CONDITION	N		V		S
2099	06	COOLING	N		V		S
2099	08	EFFECTIVE			V		S
2099	08	ENTHALPY	N		V		S
2099	06	FLOW	N		V	M	S
2099	08	HEAT			V		S
2099	06	LAYER				M	S
2099	10	MECHANISM	N				S
2099	10	POINT		T			
2099	10	SHIELDING			V		S
2099	06	SOLID	N		V	M	S
2099	10	STAGNATION		T	V	M	S

2099	08	STREAM			V	M	S
2099	08	SURFACE			V	M	S
2099	10	THEORETICAL		T	V	M	
2099	08	TRANSFER	N				S
2099	08	VAPOURIZATION	N		V		S
2099	06	WALL			V	M	S
2100	08	ABLATING			V		S
2100	10	ABLATION		T	V	M	S
2100	09	ANALYSIS	N		V	M	S
2100	08	BEHIND			V		S
2100	10	BOUNDARY			V	M	S
2100	06	COMBUSTION	N		V	M	S
2100	06	COMPRESSIBLE			V	M	S
2100	10	COOLING	N		V	M	S
2100	06	CYLINDER	N			M	S
2100	10	DERIVATION	N			M	S
2100	06	DOWNSTREAM			V	M	S
2100	06	EFFECT	N		V	M	S
2100	10	EFFECTIVE			V	M	S
2100	08	EQUILIBRIUM			V	M	S
2100	07	EXPERIMENTAL			V		S
2100	06	FLOW	N		V		S
2100	10	HEAT			V		S
2100	06	HEMISPHERICAL			V	M	S
2100	06	INCONEL			V	M	
2100	08	LAMINAR				M	S
2100	10	LAYER	N				S
2100	06	LOCAL			V	M	S
2100	08	MATERIAL	N				S
2100	08	NONABLATING			V	M	S
2100	06	NOSEPIECE	N		V	M	S
2100	09	PREDICTION	N		V	M	S
2100	06	RADIATION	N		V	M	S
2100	06	RATIO			V	M	S
2100	10	RELATIONSHIP	N		V		S
2100	10	RESULT	N				S
2100	08	STAGNATION				M	S
2100	06	STREAM			V		S
2100	06	SURFACE			V	M	S
2100	08	TEFLON			V		S
2100	06	TEMPERATURE	N		V		S
2100	07	TEST	N				S
2100	08	THREEDIMENSIONAL					S
2100	10	TRANSPIRATION			V		S
2100	06	TURBULENT			V	M	S
2100	06	TWODIMENSIONAL					S
2100	06	WALL			V	M	S
2101	10	ABLATION		T	V	M	S
2101	06	AIR			V	M	S
2101	10	CAPACITANCE			V	M	S
2101	06	CHANGE	N		V	M	S
2101	10	CONTINUOUS			V		S
2101	08	DEGREE			V	M	

2101	06	ETHYLENE				M	S
2101	06	EXPERIMENTAL			V		S
2101	08	FAHRENHEIT	N				S
2101	06	FLIGHT			V	M	S
2101	08	HEAT			V	M	S
2101	06	HEATED				M	
2101	10	VARIABLE					S
2102	08	ALTITUDE	N		V	M	S
2102	06	ATMOSPHERE	N		V	M	S
2102	09	DATA	N		V	M	S
2102	07	EFFECT	N		V		S
2102	06	EXTREME			V		
2102	10	FIVESTAGE		T		M	S
2102	10	FLIGHT					
2101	06	HIGH			V		S
2101	06	JET	N		V		S
2101	06	LENGTH			V	M	S
2101	10	MEASUREMENT	N		V	M	S
2101	04	PHOTOGRAPHIC			V	M	S
2101	06	POLYMER			V	M	S
2101	06	PROBE			V		S
2101	10	RATE	N	T			S
2101	04	RECORD	N		V	M	S
2101	10	SENSOR	N	T	V	M	S
2101	08	SHIELD	N		V	M	S
2101	06	SIMULATED				M	S
2101	08	STAGNATION			V		
2101	06	SYSTEM	N		V		S
2101	08	TEFLON			V	M	S
2101	06	TELEMETERING			V	M	S
2101	06	TEMPERATURE			V	M	S
2101	06	TEST	N		V		S
2101	06	TYPE	N			M	S
2102	10	FUEL		T		M	S
2102	08	LOAD	N		V	M	S
2102	06	MAXIMUM					S
2102	06	MILES	N		V	M	S
2102	06	NAUTICAL				M	S
2102	08	PAY			V		S
2102	06	POUND			V	M	S
2102	10	ROCKET		T	V		S
2102	10	SOLID		T		M	
2102	10	SOUNDING		T	V	M	S
2102	10	SYSTEM	N	T		M	S
2102	10	TEST			V		
2102	06	TRAJECTORY	N				S
2102	06	UPPER			V		
2102	06	VEHICLE	N		V	M	S
2102	06	VELOCITY	N		V		S
2102	08	WIND			V	M	
2103	08	ALTITUDE	N		V		S

2103	10	ATMOSPHERE	N	T	V		
2103	10	DENSITY	N	T	V		
2103	08	LATITUDE	N				
2103	09	MEASUREMENT	N				S
2103	10	PRESSURE	N	T	V	M	
2103	08	PROPAGATION	N		V		
2103	09	ROCKET		T		M	S
2103	08	SEASON	N			M	S
2103	08	SOUND					S
2103	10	TEMPERATURE	N	T	V		S
2103	10	UPPER		T	V		
2104	10	AERODYNAMIC		T	V	M	S
2104	10	BLUNT		T	V	M	S
2104	08	BODY			V	M	
2104	08	CONCAVE			V	M	
2104	08	CURVATURE	N			M	S
2104	08	CYLINDER	N		V		S
2104	09	DATA	N		V		S
2104	08	EDGE	N		V		S
2104	09	EXPERIMENTAL			V	M	S
2104	08	FACED			V		S
2104	08	FLAT				M	S
2104	09	FLIGHT			V	M	S
2104	06	FLOW	N		V	M	
2104	08	HEAT			V	M	S
2104	10	HEATING	N	T	V		S
2104	08	HEMISPHERICAL			V		S
2104	06	LAMINAR			V	M	
2104	06	LEEWARD			V		S
2104	08	LOCAL			V	M	S
2104	06	LOCATION			V	M	S
2104	10	MACH	N	T			S
2104	10	NOSE	N	T	V		S
2104	08	POINT	N		V	M	S
2104	08	RADIUS			V	M	S
2104	10	RATE	N		V		S
2104	08	SEGMENT	N		V		S
2104	10	SHAPE	N	T	V	M	
2104	08	STAGNATION					S
2104	10	TEST	N		V	M	S
2104	08	TOTAL				M	S
2104	08	TRANSFER	N			M	S
2104	09	TUNNEL					
2104	06	TURBULENT			V	M	S
2104	06	UNSTEADY			V		S
2104	09	WIND			V	M	S
2104	06	WINDWARD				M	S
2111	06	AEROELASTICITY	N		V	M	S
2111	06	ASPECT			V	M	S
2111	06	BENDING			V	M	S
2111	06	BODY			V		S
2111	09	CALCULATION	N		V		S

2111	06	CANTELEVER				M	
2111	06	CONCENTRATED			V	M	S
2111	06	DEGREE			V	M	S
2111	06	DELTA			V	M	S
2111	06	DIFFERENTIAL			V	M	S
2111	06	EQUATION	N		V		S
2111	06	FIELD	N		V	M	S
2111	00	FLOW	N		V	M	S
2111	10	FLUTTER	N	T	V	M	S
2111	06	FREEDOM	N		V	M	S
2111	06	FREON					S
2111	06	FUNCTION	N		V	M	S
2111	06	GAS	N		V	M	S
2111	10	HIGH		T	V		S
2111	06	INDICIAL			V		S
2111	06	LIFT			V		S
2111	06	LINEARIZED			V		S
2111	06	MARGIN			V	M	S
2111	06	MATERIAL	N		V	M	S
2111	06	MEDIUM			V	M	S
2111	06	MODE	N			M	
2111	06	NONSTEADY			V	M	S
2111	06	OSCILLATING			V		S
2111	00	OSCILLATION	N		V		S
2111	06	PITCHING					
2111	06	PRESSURE			V		S
2111	06	PROPELLER	N		V	M	S
2111	06	RATIO	N		V	M	S
2111	06	REFERENCE			V		S
2111	10	RESEARCH	N	T	V	M	S
2111	06	ROCKET			V	M	S
2111	06	SAFETY	N		V		S
2111	06	SELECTED			V	M	S
2111	06	SMALL			V	M	S
2111	06	SONIC			V	M	S
2111	10	SPEED	N	T	V		S
2111	06	STALL			V	M	S
2111	06	STATIC			V		S
2111	07	SUPERSONIC			V	M	S
2111	06	SWEPT			V		S
2111	06	TEST	N		V		S
2111	06	TESTING	N		V	M	S
2111	06	THEORY	N		V		S
2111	06	TUNNEL			V	M	S
2111	06	TYPE			V		
2111	06	VARIABLE			V		S
2111	06	VEHICLE	N		V	M	S
2111	06	VERY			V	M	S
2111	06	WEIGHT	N		V		SA
2111	06	WIND			V	M	S
2111	06	WING	N		V		S
2150	10	ALTITUDE			V	M	S
2150	10	ATMOSPHERIC				M	
2150	10	DENSITY	N	T	V		S
2150	09	ERROR	N				
2150	10	GAUGE			V		S

2150	10	IONIZATION					S
2150	09	MEASUREMENT	N	T		M	
2150	09	MOUNTED			V	M	S
2150	09	RESULT	N	T	V	M	
2150	10	SATELLITE	N	T			S
2150	09	SINGLY				M	S
2153	08	AEROFOIL	N			M	S
2153	08	ARC					S
2153	09	AXISYMMETRIC			V	M	S
2153	08	BODY	N		V		S
2153	10	CHOKED		T	V		
2153	08	CIRCULAR			V	M	S
2153	08	CONE				M	S
2153	08	CYLINDER	N		V		S
2153	08	DIMENSION	N		V	M	S
2153	07	DISTRIBUTION	N		V	M	S
2153	08	DOUBLE			V	M	S
2153	07	EFFECT	N		V	M	S
2153	09	FLOW	N	T	V		S
2153	09	FREE		T		M	S
2153	08	INTERFERENCE	N		V	M	
2153	10	MACH	N	T	V		S
2153	08	MODEL			V	M	S
2153	08	NACA			V	M	S
2153	08	PARABOLIC			V	M	
2153	07	PRESSURE			V	M	S
2153	08	REFLECTION			V		S
2153	07	RESULT	N		V		S
2153	09	SIMULATION	N	T	V		
2153	09	SOLID			V		S
2153	09	STREAM		T	V		S
2153	07	TEST	N				S
2153	07	THEORY	N		V	M	S
2153	10	TRANSONIC			V	M	S
2153	10	TUNNEL	N	T	V	M	S
2153	09	TWODIMENSIONAL			V		
2153	09	UNBOUNDED			V		
2153	09	WALL			V	M	
2153	08	WAVE			V	M	S
2153	08	WEDGE			V	M	
2153	10	WIND		T	V	M	S
2154	08	ANGLE			V	M	S
2154	08	ARTIFICIAL			V	M	S
2154	08	ATTACK			V	M	
2154	08	BLOCKAGE			V	M	
2154	10	BOUNDARY		T	V	M	
2154	05	CHANGE					S
2154	08	CHOKING	N		V	M	S
2154	06	CONDITION	N		V	M	S
2154	08	CORRECTION	N		V	M	S
2154	06	CROSSFLOW				M	S
2154	06	DENSITY			V		S

2154	05	FLOW	N		V		S
2154	05	INDUCED				M	S
2154	10	INTERFERENCE	N		V		S
2154	10	LAYER	N	T	V		S
2154	06	MASS					S
2154	05	NORMAL			V		S
2154	09	PERTURBATION			V	M	
2154	10	SECTION		T	V		S
2154	06	SHEAR			V	M	
2154	06	SLOPE	N		V	M	S
2154	09	SMALL			V	M	S
2154	06	STREAMLINE			V		S
2154	10	TEST		T	V	M	S
2154	09	THEORY	N			M	S
2154	08	THICKENING			V	M	S
2154	10	TRANSONIC		T		M	S
2154	10	TUNNEL	N			M	
2154	10	WALL	N	T		M	S
2154	10	WIND					S
2155	06	BODY				M	S
2155	10	BOUNDARY		T		M	S
2155	08	CHOKING			V	M	S
2155	09	DISTRIBUTION	N		V		S
2155	09	DRAG	N		V	M	S
2155	09	FLOW	N		V		
2155	09	HIGH		T	V	M	
2155	10	INTERFERENCE	N		V		
2155	10	LAYER	N	T	V		
2155	07	MACH				M	S
2155	09	MEASUREMENT	N	T	V	M	S
2155	10	MODEL	N				
2155	07	NUMBER	N			M	S
2155	09	PRESSURE					S
2155	06	REVOLUTION	N		V		S
2155	09	SUBSONIC		T	V		S
2155	10	THICKENING			V		S
2155	10	TUNNEL		T	V		S
2155	06	TWODIMENSIONAL				M	S
2155	10	WALL		T		M	
2155	10	WIND		T	V	M	
2155	06	WING	N		V	M	
2157	08	AIR	N		V		S
2157	06	BALLISTIC			V	M	S
2157	08	BLUNT			V	M	S
2157	08	BODY	N		V		S
2157	07	BOUNDARY			V		
2157	09	DESIGN	N		V		S
2157	08	DETACHED			V		S
2157	08	DETACHMENT			V		S
2157	08	DISTANCE	N		V	M	S
2157	09	DISTRIBUTION	N		V	M	S
2157	[illegible]	DRIVEN			V		S

2157	08	EDGE	N		V		S	
2157	07	EQUILIBRIUM			V	M	S	
2157	08	EXCESS			V		S	
2157	08	FLAT			V		S	
2157	06	FLIGHT				M	S	
2157	07	FLOW	N		V	M	S	
2157	05	FLUID			V	M	S	
2157	08	HELIUM	N		V	M	S	
2157	08	HEMISPHERE	N		V	M	S	
2157	07	HIGH			V		S	
2157	08	HYDROGEN			V	M	S	
2157	10	HYPERSONIC		T	V	M	S	
2157	08	IGNITED			V	M	S	
2157	08	INTERACTION	N		V		S	
2157	07	LAYER			V	M	S	
2157	08	LEADING			V		S	
2157	05	LONG			V		S	
2157	06	MACH	N		V		S	
2157	05	MECHANICS	N				S	
2157	06	MISSILE	N		V	M	S	
2157	08	MIXTURE			V	M	S	
2157	08	NOZZLE	N		V		S	
2157	08	OXYGEN			V	M		
2157	08	PLATE	N		V	M	S	
2157	08	PRESSURE			V			
2157	05	RANGE			V		S	
2157	06	SATELLITE	N		V	M	S	
2157	10	SHOCK		T	V	M	S	
2157	08	STAGNATION			V		S	
2157	08	STOICHIOMETRIC			V		S	
2157	08	STRONG			V	M	S	
2157	08	SURFACE			V	M	S	
2157	07	TEMPERATURE	N		V	M	S	
2157	07	TEST	N		V	M	S	
2157	08	TUBE	N		V	M	S	
2157	10	TUNNEL	N	T	V	M	S	
2157	07	TWODIMENSIONAL			V		S	
2157	08	VELOCITY	N		V	M	S	
2157	08	WAVE	N			M	S	
2187	08	ANALYTICAL					S	
2187	08	ASSOCIATED					S	
2187	10	BOUNDARY		T		M	S	
2187	06	DATA	N		V	M	S	
2187	06	EXPERIMENTAL			V			
2187	08	FLOW			V		S	
2187	10	INDUCED		T				
2187	10	LAYER		T	V		S	
2187	08	MACH				M	S	
2187	08	NOZZLE			V	M		A
2187	10	NOZZLE	N	T	V	M		
2187	10	OVEREXPANDED		T	V	M	S	
2187	08	POINT	N		V	M	S	
2187	09	PREDICTION	N			M	S	
2187	10	PRESSURE			V	M	S	
2187	08	RATIO	N		V	M	S	
2187	08	REGIME	N			M		

2187	10	RISE			V	M	S
2187	10	SEPARATION	N	T	V	M	
2187	10	SHOCK		T			
2187	08	SIMPLE				M	S
2187	08	SOLUTION	N		V	M	S
2187	08	STREAM			V		S
2187	10	SUPERSONIC				M	S
2274	08	AIR	N		V		S
2274	08	ALTITUDE			V		
2274	08	ANGLE	N			M	S
2274	10	BLUNT		T			S
2274	10	BODY	N	T		M	S
2274	07	BOUNDARY			V	M	S
2274	07	CONDITION	N		V	M	S
2274	08	CONE			V	M	S
2274	07	DEGREE			V	M	S
2274	07	DENSITY			V	M	S
2274	08	DETACHMENT			V		S
2274	08	DISTANCE	N		V	M	S
2274	07	DISTRIBUTION	N		V	M	S
2274	09	EFFECT	N	T		M	S
2274	08	EQUILIBRIUM	N		V		
2274	08	EXPANSION			V		S
2274	09	EXPERIMENT	N		V		S
2274	07	FLAT			V	M	S
2274	09	FLOW	N	T	V	M	S
2274	08	FROZEN			V		S
2274	10	GAS		T	V	M	S
2274	08	HEATED			V	M	S
2274	08	HEMISPHERE	N		V	M	S
2274	07	HIGH			V		S
2274	09	HYPERSONIC		T			
2274	08	INTERACTION	N		V		S
2274	07	LAMINAR			V	M	S
2274	07	LAYER			V		S
2274	08	LOCATION			V	M	S
2274	07	LOW			V	M	S
2274	08	LUMINOUS			V		S
2274	07	MACH	N		V		S
2274	08	NOZZLE			V	M	S
2274	07	PHOTOGRAPH	N		V		S
2274	07	PLATE	N		V	M	S
2274	08	POINT	N		V	M	
2274	07	PRESSURE	N		V		
2274	08	PROFILE	N		V		S
2274	08	RAREFIED			V	M	S
2274	10	REAL		T	V	M	S
2274	07	REGION	N		V		S
2274	08	SHAPE	N		V	M	S
2274	10	SHOCK			V	M	S
2274	07	SIMULATION			V		S
2274	08	SONIC			V		S
2274	08	STAGNATION			V		S
2274	08	STATIC			V	M	
2274	07	TEMPERATURE	N		V	M	
2274	08	THERMAL			V	M	S

2274	08	THICKNESS	N		V		S
2274	09	TUNNEL	N		V	M	S
2274	07	TWODIMENSIONAL			V	M	S
2274	08	WAVE			V	M	S
2274	08	WEDGE			V		S
2313	08	AIR	N		V	M	S
2313	06	ATTENUATION			V	M	S
2313	06	BOUNDARY			V	M	S
2313	08	CONTACT			V	M	S
2313	06	CROSS			V	M	S
2313	07	DATA	N		V	M	S
2313	06	DIAPHRAGM	N		V	M	S
2313	08	DISTURBANCE			V		S
2313	08	DRIVING			V	M	S
2313	08	DURATION	N		V	M	S
2313	08	END			V	M	S
2313	08	ENTRY	N		V	M	S
2313	08	EXPANSION			V		S
2313	07	EXPERIMENTAL			V	M	S
2313	08	FALL			V		S
2313	09	FLOW		T	V	M	
2313	06	GAS			V		S
2313	06	GRADIENT	N		V	M	S
2313	08	HEAD			V		S
2313	06	HIGH			V	M	S
2313	08	HYDROGEN					S
2313	08	INTERACTION			V	M	S
2313	06	LAYER			V		S
2313	06	LOW			V	M	S
2313	08	MACH	N		V	M	S
2313	06	MAIN			V	M	S
2313	06	MEASUREMENT	N		V		S
2313	08	NOZZLE			V	M	
2313	08	ORIGINATING				M	S
2313	06	PERFECT			V	M	S
2313	09	PERFORMANCE	N		V	M	
2313	08	PHOTOMULTIPLIER			V		S
2313	07	PREDICTION	N		V		S
2313	08	PRESSURE			V	M	S
2313	08	PRIMARY			V	M	S
2313	08	RANGE			V	M	S
2313	10	REFLECTED		T			S
2313	10	REFLECTION			V	M	S
2313	06	REYNOLDS	N		V	M	S
2313	08	RUNNING			V	M	S
2313	06	SECTIONAL			V		S
2313	06	SHAPE			V	M	S
2313	10	SHOCK	N	T	V	M	S
2313	06	SIZE			V	M	S
2313	06	STRAIGHT				M	S
2313	08	SURFACE	N		V	M	S
2313	08	TAIL			V	M	S
2313	07	THEORETICAL			V	M	
2313	06	THEORY	N		V		S
2313	06	THROUGH			V		S
2313	08	TIME			V	M	SA

2313	08	TUBE	N		V		S
2313	10	TUNNEL	N	T	V	M	S
2313	08	UNHEATED			V	M	S
2313	08	UNIFORM			V	M	S
2313	06	UPSTREAM			V	M	S
2313	06	WALL			V	M	S
2313	08	WAVE			V		S
2316	06	ARC	N		V	M	S
2316	08	ARGON			V		S
2316	10	BEAM	N	T	V	M	S
2316	06	CARBON			V	M	S
2316	08	CHLORIDE			V		
2316	08	DISEQUILIBRIUM	N			M	S
2316	09	DOUBLE		T	V		S
2316	08	EXCITATION	N		V	M	
2316	08	FILTER	N		V	M	SA
2316	08	FRONT	N		V	M	S
2316	07	HYPERSONIC			V		S
2316	08	INTERFERENCE			V		S
2316	08	IODIDE	N		V		S
2316	10	LIGHT					S
2316	10	LINE		T	V	M	
2316	09	MEASUREMENT	N	T	V		S
2316	08	NITROGEN			V		S
2316	08	OSCILLOGRAPH	N		V	M	
2316	08	OXYGEN				M	S
2316	08	RADIATIVE					
2316	08	RELAXATION				M	S
2316	10	REVERSAL	N	T	V		
2316	08	SALT	N			M	S
2316	10	SHOCK		T		M	
2316	06	SINGLE			V	M	S
2316	08	SODIUM			V		
2316	10	SPECTRUM		T	V	M	S
2316	10	TEMPERATURE		T		M	S
2316	08	TUBE	N		V	M	
2316	10	WAVE	N	T	V		S
2317	08	ACTUAL			V	M	
2317	09	ANALYSIS	N		V		S
2317	10	ATTENUATION			V	M	S
2317	08	BEHIND			V	M	S
2317	08	BOUNDARY				M	
2317	06	CONSERVATION				M	S
2317	08	CONSTANT			V	M	S
2317	08	DIAMETER					S
2317	06	EQUATION	N		V	M	S
2317	08	EXPERIMENTAL			V		S
2317	08	FLOW			V	M	S
2317	08	GAS				M	S
2317	08	IDEAL			V		S
2317	08	INITIATED			V	M	
2317	08	INTERFACE	N		V	M	S

2317	08	LAYER			V		S
2317	08	LENGTH				M	S
2317	08	LOSS			V		S
2317	06	MASS			V		S
2317	08	REAL			V	M	S
2317	10	SHOCK	N	T	V	M	S
2317	08	STRONG			V	M	S
2317	08	TEST			V	M	S
2317	10	TESTING		T	V	M	S
2317	09	THEORETICAL				M	S
2317	10	TIME	N	T	V	M	S
2317	10	TUBE	N	T	V	M	
2317	10	WAVE	N		V	M	S
2318	09	BLUNT				M	S
2318	09	BODY	N		V	M	S
2318	09	BOW			V	M	S
2318	08	BURSTING					
2318	08	DAMPING			V	M	S
2318	06	FLAME			V	M	
2318	09	FLOW	N			M	S
2318	10	GUN		T	V	M	S
2318	10	HYPERSONIC		T	V	M	
2318	10	LINE		T	V		S
2318	09	MEASUREMENT	N	T	V		
2318	09	METHOD	N	T	V	M	
2318	08	PISTON	N		V	M	
2318	08	PLATE	N		V	M	S
2318	08	PRESSURE			V	M	S
2318	07	RATIO	N		V		S
2318	07	REMOVAL					
2318	08	RESERVOIR					S
2318	10	REVERSAL		T		M	S
2318	09	SHOCK					
2318	10	SODIUM		T	V	M	S
2318	10	STAGNATION		T	V		S
2318	10	TEMPERATURE	N	T			S
2318	10	TUNNEL	N	T	V		
2318	09	WAVE	N		V	M	
2319	10	BLUNT		T	V		S
2319	10	BODY	N	T	V	M	S
2319	06	BOUNDARY			V		S
2319	07	CONDITION	N				S
2319	08	CONE			V	M	S
2319	06	DENSITY			V	M	S
2319	06	DETACHED			V	M	S
2319	08	DETACHMENT					S
2319	08	DISTANCE	N		V	M	
2319	08	DISTRIBUTION	N		V	M	S
2319	09	EFFECT	N	T	V	M	S
2319	06	EQUILIBRIUM	N		V		S
2319	06	EXPANSION	N				S
2319	06	FLAT			V	M	

2319	09	FLOW	N	T	V	M	S
2319	06	FROZEN			V		S
2319	10	GAS		T	V	M	S
2319	06	HEAT			V	M	S
2319	08	HEMISPHERE	N		V		S
2319	09	HYPERSONIC		T			S
2319	06	INTERACTION	N		V	M	S
2319	06	LAYER	N			M	S
2319	08	LOCATION	N		V	M	S
2319	05	LOW			V	M	S
2319	06	LUMINOSITY	N		V	M	
2319	06	MACH			V		S
2319	05	MODIFIED			V		S
2319	06	NEWTONIAN			V	M	S
2319	08	NOZZLE	N		V	M	S
2319	06	PLANETARY			V		S
2319	06	PLATE			V	M	S
2319	08	POINT			V		
2319	08	PRESSURE	N		V	M	S
2319	10	REAL		T	V	M	S
2319	06	REENTRY	N		V		S
2319	08	SHAPE	N		V		S
2319	10	SHOCK			V		S
2319	08	SONIC			V		S
2319	06	SPACE			V		S
2319	08	STAGNATION			V	M	
2319	08	STATIC			V	M	S
2319	07	TEMPERATURE	N			M	S
2319	09	TEST	N		V		S
2319	05	THEORY	N		V	M	
2319	06	THERMAL			V		S
2319	06	TRANSFER	N		V	M	S
2319	08	TUBE			V		S
2319	10	TUNNEL			V	M	
2319	06	TWODIMENSIONAL			V	M	S
2319	06	VEHICLE	N		V	M	S
2319	08	WAVE			V		S
2321	06	BODY	N		V		S
2321	10	BOUNDARY	N	T	V	M	S
2321	05	COEFFICIENT	N		V	M	S
2321	06	DAMPING	N		V	M	S
2321	06	DEFLECTION	N				
2321	08	DISSIPATIVE			V	M	S
2321	06	DISTRIBUTION	N		V		S
2321	08	DISTURBANCE	N		V	M	S
2321	06	DRAG			V		S
2321	08	FLEXIBILITY	N		V	M	S
2321	10	FLEXIBLE		T	V		S
2321	08	HELMHOLTZ			V	M	S
2321	10	HYDRODYNAMIC	N	T	V	M	S
2321	08	INSTABILITY	N		V	M	S
2321	06	INTERNAL			V		S
2321	08	KELVIN			V	M	S
2321	07	LAYER			V	M	S
2321	06	MATERIAL			V		S
321	08	NONDISSIPATIVE					S

2321	06	PRESSURE			V		
2321	05	REDUCTION	N				S
2321	06	RESPONSE			V	M	
2321	08	SCHLICHTING			V	M	S
2321	06	SINUSOIDAL			V		S
2321	08	SKIN			V	M	S
2321	07	SMALL			V		S
2321	06	SOLID				M	S
2321	10	STABILITY	N	T	V	M	S
2321	06	STIFFNESS	N		V	M	S
2321	08	SURFACE	N		V		S
2321	07	THEORY	N		V		S
2321	08	TOLLMIEN			V		S
2321	06	TRAVELLING			V	M	S
2321	06	UNDERWATER	N		V		
2321	08	WAVE	N		V		S
2322	09	ANALYTIC			V	M	
2322	09	APPROXIMATE			V		
2322	08	ATTACHED			V	M	S
2322	09	BOUNDARY	N	T		M	S
2322	08	COMPRESSION			V	M	S
2322	07	CONSTANT			V		S
2322	08	DENSITY			V	M	S
2322	08	DISPLACEMENT			V		S
2322	10	ELASTIC			V		S
2322	09	EQUATION	N	T	V	M	S
2322	07	EXPOSED				M	S
2322	07	FAST					S
2322	08	FIXED			V	M	S
2322	10	FLAT			V	M	S
2322	10	FLEXIBLE		T	V	M	
2322	08	FLEXURAL			V	M	S
2322	08	FLUID	N		V		
2322	07	FREE			V		S
2322	07	HEAVY			V		S
2322	10	HOMOGENEOUS			V	M	S
2322	09	INCOMPRESSIBLE					S
2322	07	INNER			V	M	S
2322	07	INTERIOR			V		S
2322	10	ISOTROPIC				M	S
2322	09	LAMINAR				M	S
2322	09	LAYER	N	T	V	M	S
2322	07	LIGHT			V	M	S
2322	08	LONGITUDINAL			V		
2322	07	MATERIAL	N			M	S
2322	10	MODE	N		V	M	S
2322	08	NEUTRAL			V		S
2322	10	NONDISSIPATING			V	M	S
2322	10	OSCILLATION	N		V	M	
2322	10	PLATE			V		S
2322	08	PROPAGATING				M	
2322	07	RATIO				M	S
2322	08	RAYLEIGH				M	S
2322	08	RESONANCE	N		V	M	S
2322	08	RIGIDLY			V	M	S
2322	08	SHEAR			V	M	S

2322	08	SHEET			V	M	S
2322	07	SLOWLY				M	S
2322	08	SOLID	N		V	M	S
2322	09	SOLUTION	N	T	V	M	S
2322	10	STABILITY	N	T	V	M	S
2322	08	STRESS	N		V	M	S
2322	08	STRUCTURE	N		V	M	S
2322	10	SURFACE	N	T	V	M	S
2322	08	THICKNESS			V	M	S
2322	08	TOLLMIENSCHLICHTING			V		S
2322	07	UNIFORM			V	M	S
2322	08	VISCOUS			V	M	S
2322	08	WAVE	N		V		S
2338	10	CENTRE		T	V	M	S
2338	09	DEGREE		T		M	
2338	09	FLOW	N		V	M	S
2338	10	FLUTTER	N	T	V	M	
2338	10	GRAVITY		T	V	M	S
2338	10	LOCATION	N	T	V		S
2338	08	MACH			V	M	
2338	09	NACA			V		
2338	00	NUMBER	N				
2338	07	.ATIO	N		V	M	S
2338	09	SECTION	N			M	S
2338	08	SPEED			V	M	
2338	06	SUPERSONIC			V	M	S
2338	10	SWEPTBACK		T			S
2338	09	TEST	N		V	M	
2338	10	TRANSONIC		T			S
2338	09	TUNNEL			V		
2338	09	WIND					S
2338	10	WING	N	T			S
2339	07	AERODYNAMIC			V		S
2339	09	ANALYSIS	N	T	V	M	S
2339	08	ANGLE	N		V		
2339	06	ASPECT				M	S
2339	05	ATTACK			V		S
2339	00	CALCULATION	N	T	V	M	
2339	06	CENTRE	N		V		S
2339	06	CIRCULATION			V		S
2339	07	CURVE			V	M	S
2339	07	DISTRIBUTION	N		V		S
2339	09	FINITE		T	V		
2339	09	FLOW	N		V	M	S
2339	10	FLUTTER	N	T	V	M	S
2339	08	FREQUENCY	N		V		S
2339	06	FUNCTION	N		V		S
2339	06	GRAVITY			V		S
2339	07	LIFT	N		V		S
2339	07	LOADING	N			M	
2339	07	LOCAL				M	S
2339	06	LOCATION	N		V		S

2339	07	MACH	N			M	S
2339	06	MAGNITUDE	N			M	S
2339	08	MODAL			V	M	S
2339	06	MODE	N		V	M	
2339	09	MODIFIED		T	V		S
2339	06	MOMENT	N		V	M	S
2339	06	MOTION	N			M	S
2339	06	OSCILLATORY			V	M	S
2339	06	PHASE			V		S
2339	06	PITCHING			V		S
2339	05	RATIO	N		V	M	
2339	10	RAYLEIGH			V	M	
2339	07	SECTION			V		
2339	07	SLOPE	N		V	M	S
2339	09	SPAN		T	V	M	
2339	08	SPEED	N	T	V		S
2339	07	STEADY			V	M	
2339	10	STRIP		T	V	M	S
2339	09	SUBSONIC		T	V		S
2339	09	SUPERSONIC		T	V	M	S
2339	08	SWEEP			V		
2339	10	SWEPT		T	V		S
2339	06	TAPER			V	M	S
2339	07	THEORY	N		V	M	S
2339	07	THREEDIMENSIONAL			V	M	S
2339	09	TYPE			V	M	S
2339	06	UNCOUPLED			V	M	
2339	10	UNSWEPT		T	V		
2339	06	VECTOR	N		V		S
2339	06	VIBRATION			V	M	S
2339	10	WING	N	T	V		S
2340	08	AMOUNT			V	M	S
2340	10	BENDING			V	M	S
2340	10	CONSTRUCTION	N	T	V		S
2340	10	CONTROLLING	N	T			S
2340	08	CROSS			V	M	S
2340	08	DIAMETER				M	S
2340	10	DRILLED	N		V	M	S
2340	10	DRILLING	N		V		S
2340	09	EXPERIMENT	N				
2340	00	EXPERIMENTAL					S
2340	08	FILLING			V	M	S
2340	10	HOLE					S
2340	07	MATERIAL	N		V	M	S
2340	10	MODEL		T	V		S
2340	08	PATTERN	N		V		S
2340	08	PERCENTAGE			V	M	
2340	10	PERFORATED			V		S
2340	10	PLATES					S
2340	07	RATIO	N			M	S
2340	08	REMOVED	N		V	M	S
2340	09	RESULT	N		V	M	
2340	08	SECTION	N		V	M	S
2340	08	SOFT				M	S

2340	10	SOLID		T	V	M	S
2340	06	SPANWISE				M	
2340	07	SPECIMEN	N		V	M	
2340	08	SQUARE					S
2340	06	STAGGERED			V	M	S
2340	10	STIFFNESS	N	T	V		S
2340	09	TEST					S
2340	08	THICKNESS	N				S
2340	10	TORSIONAL				M	S
2340	10	WEAKENING	N		V	M	
2340	10	WING		T			S
2341	08	ANGLE			V		S
2341	08	ASPECT				M	S
2341	06	BALSA			V		S
2341	06	COMPREG			V	M	S
2341	09	FLOW	N		V	M	S
2341	10	FLUTTER		T	V	M	S
2341	07	INCOMPRESSIBLE				M	S
2341	08	MACH	N		V	M	S
2341	06	MAGNESIUM				M	S
2341	06	MODEL	N		V		S
2341	06	PINE				M	S
2341	08	PLANFORM	N	T	V		S
2341	07	PREDICTION	N		V	M	S
2341	08	RATIO	N		V		S
2341	10	SPEED	N	T	V		S
2341	08	SWEEPBACK	N		V	M	S
2341	10	SWEPTBACK			V	M	S
2341	09	TEST	N		V	M	S
2341	07	THEORY				M	
2341	10	TRANSONIC		T	V	M	
2341	09	TUNNEL			V		
2341	07	TWODIMENSIONAL			V		S
2341	09	WIND			V		S
2341	10	WING	N	T	V	M	
2341	06	WOOD			V		
2342	09	AERODYNAMIC		T	V		S
2342	10	ARBITRARY			V		S
2342	06	ASPECT			V		S
2342	06	AXIS			V		S
2342	09	CALCULATION	N	T	V	M	S
2342	06	CENTRE			V	M	S
2342	06	CHORDWISE				M	S
2342	06	COEFFICIENT	N		V		S
2342	08	CONTINUOUS			V	M	S
2342	05	DERIVATIVE	N			M	S
2342	08	DOWNWASH	N		V		
2342	08	DUE					
2342	06	ELLIPTIC			V	M	S
2342	06	FLOW	N		V	M	S
2342	08	FORMULA			V	M	
2342	08	GENERAL			V	M	S
2342	08	HORSESHOE			V		S
2342	08	INDIVIDUAL			V	M	S

2342	06	LIFT			V	M	S
2342	10	LOAD	N		V		S
2342	08	LOADING	N	T		M	S
2342	06	MAJOR			V	M	S
2342	09	METHOD	N		V	M	S
2342	06	MINOR			V	M	S
2342	06	MOMENT			V		S
2342	06	NOLIFT			V	M	S
2342	08	PATTERN			V	M	S
2342	06	PERCENT			V	M	S
2342	08	PIVOTAL			V	M	S
2342	08	POINT	N				
2342	08	POTENTIAL			V		S
2342	06	PRESSURE	N		V	M	S
2342	06	RATIO	N		V	M	S
2342	06	RECTANGULAR			V	M	S
2342	05	ROTARY			V	M	S
2342	09	ROUTINE			V	M	S
2342	10	SHAPE	N	T	V	M	S
2342	06	SLOPE			V	M	S
2342	10	SURFACE		T	V	M	S
2342	06	SYMMETRICAL			V	M	S
2342	08	THEORY	N		V	M	S
2342	08	THIN			V		
2342	08	TOTAL			V		S
2342	06	TWODIMENSIONAL			V	M	S
2342	08	VORTEX	N		V	M	S
2342	10	WING			V	M	S
2342	06	YAW	N		V		S
2364	07	AHEAD				M	S
2364	06	ANGLE					S
2364	09	BOUNDARY		T	V		S
2364	06	DEFLECTION			V		S
2364	07	DISTRIBUTION	N		V	M	S
2364	09	EXTERNALLY			V		S
2364	10	FLAT			V		S
2364	09	FLOW	N			M	S
2364	07	FREE			V	M	S
2364	09	GENERATED			V	M	S
2364	10	INTERACTION	N	T	V	M	S
2364	09	INTERNALLY			V		S
2364	06	KINK			V	M	S
2364	07	LAMINAR			V	M	
2364	09	LAYER	N	T	V	M	S
2364	08	MACH			V		S
2364	07	NUMBER	N		V	M	S
2364	07	PATTERN	N		V		
2364	10	PLATE	N		V	M	S
2364	07	POSITION	N		V	M	S
2364	08	PRESSURE	N		V	M	S
2364	06	REATTACHMENT	N		V	M	
2364	08	REYNOLDS			V	M	
2364	08	SEPARATION			V	M	S
2364	10	SHOCK		T			S
2364	07	STREAM			V		
2364	08	STRENGTH	N		V		S

2364	09	SUPERSONIC			V	M	S
2364	09	TEST	N		V		S
2364	08	TRANSITION			V	M	S
2364	09	TUNNEL					S
2364	07	TURBULENT			V		S
2364	10	WAVE	N	T		M	S
2364	10	WEDGE			V	M	S
2364	10	WEDGE	N			M	S
2364	09	WIND			V	M	S
2367	09	BOUNDARY			V		
2367	08	CURVATURE	N	T	V		
2367	07	DISTRIBUTION	N		V	M	
2367	09	EXTENSION			V	M	S
2367	09	FLOW	N	T	V	M	S
2367	09	INVESTIGATION	N	T	V	M	S
2367	09	LAMINAR		T	V	M	S
2367	09	LAYER			V	M	
2367	07	MACH		T	V	M	
2367	09	METHOD	N		V		S
2367	07	NUMBER	N	T	V		
2367	07	PRESSURE			V	M	
2367	07	REYNOLDS		T	V	M	S
2367	10	SEPARATION	N	T	V		S
2367	06	SHOCK				M	S
2367	09	STRATFORD			V	M	
2367	09	SUPERSONIC		T	V		
2367	08	SURFACE		T	V		
2367	08	TEMPERATURE	N	T	V		
2367	09	THEORETICAL		T	V	M	
2367	05	UPSTREAM			V	M	
2367	08	WALL		T	V		S
2367	06	WAVE	N		V	M	S
2379	06	ACCELERATION	N		V		S
2379	07	AERODYNAMIC			V		S
2379	06	AIR			V	M	S
2379	08	ALTITUDE	N		V		
2379	08	ANGLE	N		V	M	
2379	08	ATMOSPHERIC			V		S
2379	08	BALLISTIC			V	M	S
2379	06	BREATHING			V		S
2379	06	DECELERATION	N		V		S
2379	08	DRAG			V		S
2379	09	FLIGHT	N	T	V	M	S
2379	08	GLIDE			V	M	S
2379	08	HEATING	N		V	M	S
2379	09	HYPERSONIC		T	V	M	S
2379	08	LIFT			V		S
2379	08	LOAD	N		V	M	S
2379	06	MOTION	N		V	M	S
2379	06	OSCILLATORY			V	M	S
2379	08	PATH			V	M	S
2379	05	PERFORMANCE	N		V		S

2379	06	PROPELLED			V	M	S
2379	10	PROPULSION			V	M	S
2379	07	RATIO	N		V		S
2379	08	REENTRY	N	T			
2379	10	ROCKET			V	M	S
2379	08	SKIP			V		S
2379	08	STABILITY	N		V		S
2379	05	SUPERSONIC			V		S
2379	09	SYSTEM	N		V	M	S
2379	08	TRAJECTORY	N		V		S
2379	08	VEHICLE	N			M	S
2379	08	WEIGHT			V	M	S
2391	07	AERODYNAMIC			V	M	S
2391	08	ALTITUDE	N		V	M	S
2391	09	ANALYSIS	N				S
2391	10	ATMOSPHERE	N		V		S
2391	10	BLUNT			V	M	S
2391	10	BODY	N		V	M	S
2391	07	CHARACTERISTIC	N			M	S
2391	07	COEFFICIENT	N		V	M	S
2391	08	COLLISION				M	S
2391	10	CONTINUUM			V	M	S
2391	10	COOLED			V		S
2391	06	COUETTE					S
2391	08	DENSITY					S
2391	09	DEVELOPMENT	N	T	V	M	S
2391	07	DISTRIBUTION	N		V		S
2391	08	DRAG					S
2391	08	EMITTED			V	M	S
2391	07	EQUATION			V		S
2391	09	FIELD	N	T			S
2391	07	FIRST			V	M	S
2391	09	FLOW	N	T	V		S
2391	08	FREE			V	M	S
2391	08	GAS			V	M	
2391	08	GEOMETRY	N		V	M	S
2391	08	HEAT			V		S
2391	09	HIGHLY				M	S
2391	09	HYPERSONIC		T	V		S
2391	08	INCIPIENT			V	M	S
2391	08	KINETIC			V	M	S
2391	08	LAYER			V		S
2391	07	LOCAL			V		S
2391	08	LOCATION	N		V	M	S
2391	07	MEAN			V		S
2391	08	MERGED			V		S
2391	08	MOLECULAR			V	M	S
2391	08	MOLECULE					S
2391	08	NAVIER			V	M	S
2391	10	NOSE			V	M	S
2391	07	PATH	N		V	M	S
2391	10	PLANETARY			V	M	S
2391	08	POINT			V	M	S
2391	06	PROFILE	N		V	M	S
2391	08	RAREFIED			V	M	S
2391	10	REENTRY		T		M	

2391	08	REGIME	N		V	M	S
2391	10	REGION	N		V	M	S
2391	08	SHEAR			V	M	S
2391	10	SHOCK			V	M	S
2391	07	SLIP	N				S
2391	07	SOLUTION	N		V		
2391	07	SPEED	N		V	M	S
2391	10	STAGNATION			V		S
2391	08	STOKES			V	M	
2391	08	STRESS	N		V	M	S
2391	08	SURFACE			V	M	S
2391	09	THEORETICAL			V		S
2391	07	THEORY			V	M	S
2391	08	THICKNESS	N		V	M	
2391	08	TRANSFER	N		V	M	S
2391	08	TRANSITIONAL				M	S
2391	06	VELOCITY			V	M	S
2391	08	VISCOUS			V	M	
2391	10	WAVE		T	V		S

APPENDIX C

QUESTION INDEXING

Question 79 What are the details of the rigourous kinetic theory of gases (Chapman-Enskog Theory)?

Index terms: Chapman Enskog gas kinetic theory

Question 100 How much is known about boundary layer flows along noncircular cylinders?

Index terms: boundary cylinder flow layer noncircular about

Question 116 How significant is the possible pressure of a dissociated free stream with respect to the realization of hypersonic simulation in high enthalpy wind tunnels?

Index terms: dissociated enthalpy free high hypersonic pressure simulation stream tunnel wind

Question 118 Do the discrepancies among current analyses of the vorticity effect on stagnation-point heat transfer result primarily from the differences in the viscosity-temperature law assumed?

Index terms: analysis assumed current difference effect heat law point result stagnation temperature transfer viscosity vorticity

Question 119 How far can one trust the linear viscosity temperature solution assumed in some of the analyses of hypersonic shock layer at low Reynolds number?

Index terms: analysis assumed far hypersonic layer linear low number one Reynolds shock solution temperature viscosity

Question 121 Has anyone explained the kink in the surge line of a multistage axial?

Index terms: axial compressor line multistage surge kink

Question 122 Have any aerodynamic derivatives been measured at hypersonic Mach numbers and comparison been made with theoretical work?

Index terms: comparison derivative hypersonic Mach measured number theoretical work

Question 123 Are the methods of measuring aerodynamic derivatives which could be adopted for use in short running time facilities?

Index terms: aerodynamic derivative facility measuring method running short time use

Question 126 What are wind-tunnel corrections for a two-dimensional aerofoil mounted off-center in a tunnel?

Index terms: aerofoil correction mounted tunnel twodimensional wind

Question 139 What is the present state of the theory of quasi-conical flows?

Index terms: flow quasiconical state theory

Question 132 What parameters can seriously influence natural transition from laminar to turbulent flow on a model in a wind tunnel?

Index terms: flow influence laminar model natural parameter transition tunnel turbulent wind

Question 136 How does a satellite orbit contract under the action of air drag in an atmosphere in which the scale height varies with altitude?

Index terms: action air altitude atmosphere drag height orbit satellite scale under

Question 137 How is the flow at transonic speeds about a delta wing different from that on a closely-related tapered sweptback wing?

Index terms: closely delta different flow speed sweptback transonic wing tapered

Question 141 Can methane-air combustion product be used as a hypersonic test medium and predict, within experimental accuracies, the results obtained in air?

Index terms: accuracy air combustion experimental hypersonic medium methane product result test

Question 145 Has anyone investigated the unsteady lift distributions on finite wings in subsonic flow?

Index terms: distribution finite flow lift subsonic unsteady wing

Question 146 What information is available for dynamic response of airplanes to gusts or blasts in the subsonic regime?

Index terms: aeroplane blast dynamic gust regime response subsonic

Question 147 Will forward or apex located controls be effective at low subsonic speeds and how do they compare with conventional trailing-edge flaps?

Index terms: apex control conventional edge effective flap forward located low speed subsonic trailing

Question 148 Given that an uncontrolled vehicle will tumble as it enters an atmosphere, is it possible to predict when and how it will stop tumbling and its subsequent motion?

Index terms: atmosphere motion tumble tumbling vehicle

Question 167 It is not likely that the airforces on a wing of a general planform oscillating in transonic flow can be determined by purely analytical methods. Is it possible to determine the airforces on a single particular planform, such as the rectuangular one by such methods?

Question 170 Is there any information on how the addition of a "boat-tail" affects the normal force on the body of various angles of incidence?

Index terms: addition angle boattail body force incidence normal

Question 181 Has any work been done on determining the nature of compressible viscous flow in a straight channel?

Index terms: channel compressible flow nature straight viscous work

Question 182 In what areas, other than low density wind tunnel flows, is viscous compressible flow in slender channels a problem?

Index terms: area channel compressible density flow low problem slender tunnel viscous wind

Question 189 Has anyone programmed a pump design method for a high-speed digital computer?

Index terms: computer design digital high method programmed pump speed

Question 190 Has anyone derived simplified pump design equations from the fundamental three-dimensional equations for incompressible nonviscous flow?

Index terms: design equation flow fundamental incompressible nonviscous pump threedimensional

Question 223 What is the magnitude of second-order wing-body interference at high supersonic Mach number?

Index terms: body high interference Mach magnitude number order second supersonic wing

Question 224 What is the best theoretical method for calculating pressure on the surface of a wing alone?

Index terms: alone calculating method pressure surface theoretical wing

Question 225 How can the effect of the boundary-layer on wing pressure be calculated, and what is its magnitude?

Index terms: boundary calculated effect layer magnitude pressure wing

Question 226 How should the Navier-Stokes difference equations be solved?

Index terms: difference equation navier stokes

Question 227 Which iterative method for solving linear difference equations is most rapidly convergent?

Index terms: convergent difference elliptic equation iterative linear method

Question 230 Technical report on measurement of ablation during flight

Index terms: ablation during flight measurement

Question 250 What determines the onset of shock-induced boundary-layer separation?

Index terms: boundary induced layer onset separation shock

Question 261 Solution of the Blasius problem with threepoint boundary conditions.

Index terms: Blasius boundary condition problem solution threepoint

Question 264 References on Lyapunov/s method on the stability of linear differential equations with periodic coefficients.

Index terms: coefficient differential equation linear Lyapunov method periodic reference stability

Question 266 Work on flow in channels at low Reynolds number.

Index terms: channel flow low number Reynolds work

Question 268 What mode of stalling can be expected for each stage of an axial compressor?

Index terms: axial compressor mode stage stalling

Question 269 Has a criterion been established for determining the axial compressor choking line?

Index terms: axial choking compressor criterion line

Question 272 Has a theory of quasi-conical flows been developed, in supersonic linearized theory, for which the upwash distribution on the lifting surface, apart from being a homogeneous function in the coordinate, is permitted to have a quite general function?

Index terms: coordinate developed distribution flow form function general homogeneous lifting linearized quasiconical supersonic surface theory upwash

Question 273 How does scale height vary with altitude in an atmosphere?

Index terms: altitude atmosphere height scale

Question 274 Jet interference with supersonic flows -- theoretical papers.

Index terms: flow interference jet paper supersonic theoretical

Question 317 Has anyone investigated theoretically whether surface flexibility can stabilize a laminar boundary layer?

Index terms: boundary flexibility laminar layer stabilize surface

Question 323 How do large changes in new mass ratio quantitatively affect wing-flutter?

Index terms: boundary change flutter large mass ratio wing

Question 360 In practice, how close to reality are the assumptions that the flow in a hypersonic shock tube using nitrogen is non-viscous and in thermodynamic equilibrium?

Index terms: assumption close equilibrium flow hypersonic nitrogen non-viscous shock thermodynamic

APPENDIX D

RELEVANCE JUDGEMENTS

Question	Number of Relevant Documents	Relevant Documents
79	3	1302 1436 1437
100	4	1785 1786 1787 1788
116	6	1317 1574 1575 1576 1578 1656
118	5	1324 1378 1666 1667 1670
119	6	1324 1378 1666 1667 1670 2391
121	3	1588 1589 1590
122	5	1597 1598 1688 1708 1713
123	4	1594 1596 1597 1598
126	2	1672 1799
130	4	1680 1681 1682 1683
132	4	1406 1606 1608 1710
136	6	1613 1614 1615 1616 1617 1618
137	6	1420 1793 1794 1795 1796 1797
141	1	1391
145	12	1698 1699 1700 1701 1702 1703 1704
		1705 1706 1779 1792 2339
146	9	1681 1698 1699 1700 1701 1702
		1703 1779 2339
147	5	1708 1709 1711 1712 1713
148	4	1717 1719 2001 2379
167	4	1916 1919 1920 1921
170	2	1360 1605
181	2	1966 1967

Question	Number of Relevant Documents	Relevant Documents
182	4	1964 1965 1967 1968
189	2	1985 1990
190	7	1984 1985 1986 1987 1988 1989 1990
223	2	2074 2075
224	5	1687 2074 2075 2076 2077
225	5	1569 1572 1655 1687 2077
226	7	2078 2080 2081 2082 2083 2084 2085
227	2	2087 2088
230	6	1983 2099 2100 2101 2103 2104
250	8	1311 1316 1335 1415 1416 1798 2364 2367
261	4	1320 1321 1322 1476
264	2	1367 1451
266	5	1351 1964 1965 1966 1967
268	5	1588 1589 1590 1592 1772
269	4	1588 1589 1590 1591
272	4	1680 1681 1682 1683
273	7	1616 1617 1619 1620 1621 1622 2150
274	5	1409 1973 1974 1997 2061
317	2	2321 2322
323	5	1879 2338 2339 2340 2341
360	8	1656 2157 2274 2313 2316 2317 2318 2319

APPENDIX E

FREQUENCY DISTRIBUTION OF POSTED TERMS

TABLE

FIRST QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
1	143	143	FLOW
2	98	241	PRESSURE
3	80	321	DISTRIBUTION
4	73	394	BOUNDARY
5	65	459	MACH
6	62	521	TUNNEL
7	61	582	RATIO
8	61	643	LAYER
9	59	702	WING
10	57	759	SUPERSONIC
11	55	814	WIND
12	55	869	SURFACE
13	53	922	DRAG
14	50	972	COEFFICIENT
15	49	1021	TEST
16	46	1067	ANGLE
17	45	1112	LIFT
18	44	1156	BODY
19	44	1200	SHOCK
20	44	1244	VELOCITY
21	43	1287	SOLUTION
22	42	1329	THEORY
23	40	1369	TEMPERATURE
24	40	1409	WAVE
25	39	1448	CALCULATION
26	37	1485	AERODYNAMIC
27	37	1522	HEAT
28	35	1557	EQUATION
29	35	1592	NUMBER
30	35	1627	TWODIMENSIONAL
31	34	1661	HYPERSONIC
32	33	1694	FLAT
33	32	1726	FORCE

TABLE

SECOND QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
34	32	1758	AIR
35	32	1790	STAGNATION
36	31	1821	SUBSONIC
37	31	1852	EDGE
38	29	1881	ATTACK
39	28	1909	EFFECT
40	28	1937	MODEL
41	28	1965	SPEED
42	27	1992	STREAM
43	27	2019	PLATE
44	27	2046	SEPARATION
45	27	2073	POINT
46	27	2100	REYNOLDS
47	27	2127	MEASUREMENT
48	27	2154	JET
49	27	2181	BLUNT
50	26	2207	HIGH
51	25	2232	SHAPE
52	25	2257	WALL
53	24	2281	DENSITY
54	24	2305	MOMENT
55	23	2328	NOZZLE
56	23	2351	LEADING
57	23	2374	VISCOUS
58	23	2397	THICKNESS
59	23	2420	TRANSFER
60	23	2443	SECTION
61	22	2465	TRANSONIC
62	22	2487	RATE
63	22	2509	LAMINAR
64	22	2531	METHOD
65	22	2553	INTERFERENCE
66	22	2575	GAS
67	21	2596	PITCHING
68	21	2617	ATMOSPHERE
69	21	2638	CONDITION
70	21	2659	STATIC
71	20	2679	CONTROL
72	20	2699	ASPECT
73	20	2719	NORMAL
74	19	2738	MOTION
75	19	2757	LOCATION
76	19	2776	FUNCTION
77	19	2795	FREE
78	19	2814	ANALYSIS
79	19	2833	PROFILE
80	19	2852	VEHICLE
81	18	2870	SKIN

TABLE.--continued

SECOND QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
82	18	2888	TOTAL
83	18	2906	STABILITY
84	18	2924	FLUID
85	18	2942	FINITE
86	18	2960	EXPERIMENTAL
87	18	2978	INTERACTION
88	18	2996	INDUCED
89	18	3014	DEGREE
90	18	3032	CIECULAR
91	17	3049	CYLINDER
92	17	3066	DISTANCE
93	17	3083	VARIATION
94	17	3100	SONIC
95	17	3117	STEADY
96	16	3133	TURBULENT
97	16	3149	INCOMPRESSIBLE
98	16	3165	COMPRESSIBLE
99	16	3181	ALTITUDE
100	16	3197	AEROFOIL
101	15	3212	PREDICTION
102	15	3227	DESIGN
103	15	3242	CHARACTERISTIC
104	15	3257	EXPANSION
105	15	3272	FIELD
106	15	3287	NUMERICAL
107	15	3302	THEORETICAL
108	15	3317	REENTRY
109	14	3331	ROCKET
110	14	3345	SHARP
111	14	3359	VORTEX
112	14	3373	NOSE
113	14	3387	EQUILIBRIUM
114	14	3401	INCIDENCE
115	14	3415	ELLIPTIC
116	14	3429	CENTRE
117	13	3442	DETERMINATION
118	13	3455	DAMPING

TABLE

THIRD QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
119	13	3468	POTENTIAL
120	13	3481	BLADE
121	13	3494	HEATING
122	13	3507	FLIGHT
123	13	3520	FRICTION
124	13	3533	LOW
125	13	3546	SWEPTBACK
126	13	3559	SMALL
127	13	3572	UPPER
128	13	3585	TRANSITION
129	13	3598	REVOLUTION
130	13	3611	SATELLITE
131	12	3623	SPANWISE
132	12	3635	THREEDIMENSIONAL
133	12	3647	THRUST
134	12	3659	TIME
135	12	3671	VORTICITY
136	12	3683	LOADING
137	12	3695	LOAD
138	12	3707	GRADIENT
139	12	3719	AXIAL
140	12	3731	DELTA
141	12	3743	DATA
142	12	3755	CHORDWISE
143	12	3767	CONSTANT
144	11	3778	CONE
145	11	3789	COMPRESSOR
146	11	3800	CURVATURE
147	11	2811	FLUTTER
148	11	3822	DISPLACEMENT
149	11	3833	EXHAUSTING
150	11	3844	LOCAL
151	11	3855	LONGITUDINAL
152	11	3866	APPROXIMATION
153	11	3877	TRAILING
154	11	3888	TUBE
155	10	3898	REDUCTION
156	10	3908	TIP
157	10	3918	WEIGHT
158	10	3928	WEDGE
159	10	3938	SLOPE
160	10	3948	ZERO
161	10	3958	SOLID
162	10	3968	SWEPT
163	10	3978	REACTION
164	10	3988	SPAN
165	10	3998	RECTANGULAR
166	10	4008	PATTERN
167	10	4018	LENGTH

TABLE.--continued

THIRD QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
168	10	4028	MAXIMUM
169	10	4038	MATERIAL
170	10	4048	MASS
171	10	4058	OSCILLATION
172	10	4068	OSCILLATING
173	10	4078	ORBIT
174	10	4088	EXPERIMENT
175	10	4098	PERFORMANCE
176	9	4107	DERIVATIVE
177	9	4116	CONICAL
178	9	4125	POSITION
179	9	4134	ENTHALPY
180	9	4143	DOWNWASH
181	9	4152	FREQUENCY
182	9	4161	RANGE
183	9	4170	OSCILLATORY
184	9	4179	LIFTING
185	9	4188	MODE
186	9	4197	APPROXIMATE
187	9	4206	RELATION
188	9	4215	WAKE
189	9	4224	TRANSIENT
190	9	4233	THIN
191	9	4242	RISE
192	9	4251	UNSTEADY
193	9	4260	REGION
194	9	4269	STREAMLINE
195	8	4277	STIFFNESS
196	8	4285	SPECIFIC
197	8	4293	SYSTEM
198	8	4301	SLENDER
199	8	4309	VERTICAL
200	8	4317	SIZE
201	8	4325	ARBITRARY
202	8	4333	PERIGREE
203	8	4341	MIXING
204	8	4349	MIXED
205	8	4357	LINE
206	8	4365	PLANE
207	8	4373	RADIATION
208	8	4381	PROBLEM
209	8	4389	NOSED
210	8	4397	INDICAL
211	8	4405	INLET
212	8	4413	PLANFORM
213	8	4421	INTEGRAL
214	8	4429	FORWARD
215	8	4437	DOWNSTREAM

TABLE.--continued (3)

THIRD QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
216	8	4445	EDGED
217	8	4453	EXIT
218	8	4461	EXHAUST
219	8	4469	HEIGHT
220	8	4477	CONDUCTION
221	8	4485	DIAMETER
222	8	4493	CURVE
223	8	4501	CHANGE
224	8	4509	BENDING
225	7	4516	PITCH
226	7	4523	CHORD
227	7	4530	DIFFERENTIAL
228	7	4537	CONFIGURATION
229	7	4544	RELAXATION
230	7	4551	DISSOCIATION
231	7	4558	DISTURBANCE
232	7	4565	FORM
233	7	4572	RESULT
234	7	4579	PROPERTY
235	7	4586	PARALLEL
236	7	4593	LINEAR
237	7	4600	SYMMETRICAL
238	7	4607	ROTATING
239	7	4614	SWEEP
240	7	4621	STRESS
241	7	4628	SPHERICAL
242	7	4635	SCALE
243	7	4642	UNIFORM
244	7	4649	SIMULATION
245	7	4656	UPSTREAM
246	7	4663	THERMAL
247	6	4669	THICK
248	6	4675	VARIABLE
249	6	4681	SHEAR
250	6	4687	TYPE
251	6	4693	STALL
252	6	4699	STANDOFF
253	6	4705	VIBRATION
254	6	4711	PERIOD
255	6	4717	LINEARIZED
256	6	4723	PARABOLIC
257	6	4729	PARAMETER
258	6	4735	ONSET
259	6	4741	REFLECTION
260	6	4747	INFINITE
261	6	4753	RIGID
262	6	4759	INVISCID
263	6	4765	MOMENTUM
264	6	4771	PLANETARY

TABLE.--continued (4)

THIRD QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
265	6	4777	GRAVITY
266	6	4783	FLAP
267	6	4789	ECCENTRICITY
268	6	4795	EARTH
269	6	4801	DYNAMIC
270	6	4807	ENERGY
271	6	4813	HALF
272	6	4819	GUST
273	6	4825	IMPELLER
274	6	4831	CONTRACTION
275	6	4837	ROTATIONAL
276	6	4843	BOW
277	6	4849	BLUNTED
278	6	4855	BEHIND
279	6	4861	BASE
280	6	4867	AXISYMMETRIC
281	6	4873	AXIS
282	6	4879	ASYMPTOTIC
283	6	4885	ATMOSPHERIC
284	6	4891	ARC
285	6	4897	AFTERBODY
286	6	4903	ANALYTICAL
287	5	4908	PATH
288	5	4913	ACCELERATION
289	5	4918	BLOWING
290	5	4923	BLOCKAGE
291	5	4928	BUFFETING
292	5	4933	CHOKING
293	5	4938	CHOKED
294	5	4943	CHANNEL
295	5	4948	CENTRIFUGAL
296	5	4953	CONTINUOUS
297	5	4958	PRANDTL
298	5	4963	COMPRESSION
299	5	4968	COMPLETE
300	5	4973	CORRECTION
301	5	4978	DIFFERENCE
302	5	4983	DETACHMENT
303	5	4988	CROSS
304	5	4993	DEPENDENT
305	5	4998	DEFLECTION
306	5	5003	PHOTOGRAPH
307	5	5008	IDEAL
308	5	5013	HOT
309	5	5018	PERTURBATION
310	5	5023	GROWTH
311	5	5028	ENGINE
312	5	5033	RELATIVE

TABLE.--continued (5)

THIRD QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
313	5	5038	ELASTIC
314	5	5043	DIVERGENT
315	5	5048	GLIDER
316	5	5053	GENERALIZED
317	5	5058	REAR
318	5	5063	ENTRY
319	5	5068	EXTERNAL
320	5	5073	MOLECULAR
321	5	5078	MODIFIED
322	5	5083	NEWTONIAN
323	5	5088	ISENTROPIC
324	5	5093	INVESTIGATION
325	5	5098	ONEDIMENSIONAL
326	5	5103	OXYGEN
327	5	5108	NONVISCOUS
328	5	5113	NONLINEAR
329	5	5118	NONEQUILIBRIUM
330	5	5123	LONG
331	5	5128	MAIN
332	5	5133	VISCOSITY
333	5	5138	WORKING
334	5	5143	SURVEY
335	5	5148	STUDY
336	5	5153	SPACE
337	5	5158	SLIP
338	5	5163	STRUCTURE
339	5	5168	STRENGTH
340	5	5173	TESTING
341	5	5178	SINGLE

TABLE

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
342	5	5183	SINKING
343	5	5188	SIMULATED
344	4	5192	TWO
345	4	5196	TRIANGULAR
346	4	5200	TURBOJET
347	4	5204	VANE
348	4	5208	TRANSITIONAL
349	4	5212	TRAJECTORY
350	4	5216	THROAT
351	4	5220	STATE
352	4	5224	WIDTH
353	4	5228	TAIL
354	4	5232	TABLE
355	4	5236	SUCTION
356	4	5240	SURGE
357	4	5244	VECTOR
358	4	5248	STAGE
359	4	5252	SHROUD
360	4	5256	SIDESLIP
361	4	5260	NONLIFTING
362	4	5264	PARTICLE
363	4	5268	PANEL
364	4	5272	PROBE
365	4	5276	OIL
366	4	5280	ORBITAL
367	4	5284	INITIAL
368	4	5288	INTEGRATION
369	4	5292	NITROGEN
370	4	5296	NOISE
371	4	5300	MIXTURE
372	4	5304	NACELLE
373	4	5308	MULTIPLE
374	4	5312	FACTOR
375	4	5316	FACE
376	4	5320	ENTROPY
377	4	5324	PHASE
378	4	5328	ESTIMATION
379	4	5332	RESPONSE
380	4	5336	RADIAL
381	4	5340	FUSELAGE
382	4	5344	FULLY
383	4	5348	FROZEN
384	4	5352	FORMULA
385	4	5356	FOREBODY
386	4	5360	FRACTION
387	4	5364	DIVERGENCE
388	4	5368	PENETRATION
389	4	5372	POWER
390	4	5376	DISSOCIATING

TABLE.--continued (2)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
391	4	5380	SEPARATED
392	4	5384	EFFICIENCY
393	4	5388	EDDY
394	4	5392	SOLAR
395	4	5396	ROLLING
396	4	5400	REAL
397	4	5404	DRIVING
398	4	5408	HEAD
399	4	5412	HUB
400	4	5416	HORSESHOE
401	4	5420	ROTATION
402	4	5424	HELIUM
403	4	5428	SEGMENT
404	4	5432	PROPULSIVE
405	4	5436	DECELERATION
406	4	5440	DETACHED
407	4	5444	CORNER
408	4	5448	COOLING
409	4	5452	COMPRESSIBILITY
410	4	5456	CONVECTION
411	4	5460	CONVERGENT
412	4	5464	CONVECTIVE
413	4	5468	CONDUCTIVITY
414	4	5472	SCHLIEREN
415	4	5476	CHEMICAL
416	4	5480	PERCENT
417	4	5484	CAMBER
418	4	5488	BLASIUS
419	4	5492	ATTACHED
420	4	5496	BEHAVIOR
421	4	5500	ABLATION
422	4	5504	AIRCRAFT
423	3	5507	ANALYTIC
424	3	5510	AMBIENT
425	3	5513	ADIABATIC
426	3	5516	RECOVERY
427	3	5519	SPUTNIK
428	3	5522	AREA
429	3	5525	BLADING
430	3	5528	BLOW
431	3	5531	BLUNTNESS
432	3	5534	STALLING
433	3	5537	BALANCE
434	3	5540	ROUGHNESS
435	3	5543	BOATTAIL
436	3	5546	CHEMICALLY
437	3	5549	REQUIREMENT
438	3	5552	CLOSED

TABLE.--continued (3)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
439	3	5555	STATIONARY
440	3	5558	COMBINED
441	3	5561	CIRCULATION
442	3	5564	PLOTTING
443	3	5567	RAYLEIGH
444	3	5570	CONSTRUCTION
445	3	5573	SPHERE
446	3	5576	CONVERGING
447	3	5579	CONVERGENCE
448	3	5582	ROTOR
449	3	5585	CONTOUR
450	3	5588	STOKES
451	3	5591	CONTINUUM
452	3	5594	COMBUSTION
453	3	5597	STRAIGHT
454	3	5600	COMPUTER
455	3	5603	COORDINATE
456	3	5606	CONVEX
457	3	5609	DEVELOPMENT
458	3	5612	DECAY
459	3	5615	STREAMWISE
460	3	5618	CYLINDRICAL
461	3	5621	DISCONTINUITY
462	3	5624	DISCHARGE
463	3	5627	DIHEDRAL
464	3	5630	STRIP
465	3	5633	STRONG
466	3	5636	STRUCTURAL
467	3	5639	HISTORY
468	3	5642	HEMISPHERICAL
469	3	5645	HEMISPHERE
470	3	5648	SUBLIMATION
471	3	5651	IMPACT
472	3	5654	SOURCE
473	3	5657	SUCCESSIVE
474	3	5660	HYDROGEN
475	3	5663	SEMIINFINITE
476	3	5666	SEMIMAJOR
477	3	5669	INCREMENTAL
478	3	5672	IMPULSE
479	3	5675	SOUND
480	3	5678	DOUBLE
481	3	5681	DURATION
482	3	5684	EFFECTIVE
483	3	5687	ELECTRICAL
484	3	5690	ELASTICITY
485	3	5693	DISSOCIATED
486	3	5696	ROOT
487	3	5699	SWEEPBACK
488	3	5702	SLOTTED

TABLE.--continued (4)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
489	3	5705	SLOT
490	3	5708	FORMATION
491	3	5711	FREEDOM
492	3	5714	FRICTIONAL
493	3	5717	GENERATORS
494	3	5720	SERIES
495	3	5723	GRAPHITE
496	3	5726	GEOMETRY
497	3	5729	FLUX
498	3	5732	FLEXIBILITY
499	3	5735	EXCITATION
500	3	5738	EXPLORER
501	3	5741	SINUSODIAL
502	3	5744	MOVING
503	3	5747	TANGENTIAL
504	3	5750	NACA
505	3	5753	TAPER
506	3	5756	RECOMBINATION
507	3	5759	MISSILE
508	3	5762	NODE
509	3	5765	NEARLY
510	3	5768	NAVIERSTOKES
511	3	5771	INTERMEDIATE
512	3	5774	INFLUENCE
513	3	5777	REGIME
514	3	5780	IONIZED
515	3	5783	IONIZATION
516	3	5786	PISTON
517	3	5789	ITERATIVE
518	3	5792	REATTACHMENT
519	3	5795	OPERATION
520	3	5798	PHENOMENA
521	3	5801	OBLATE
522	3	5804	PARTIAL
523	3	5807	PART
524	3	5810	THERMODYNAMIC
525	3	5813	OUTLET
526	3	5816	OUTBOARD
527	3	5819	REFLECTED
528	3	5822	LOGARITHMIC
529	3	5825	LOSS
530	3	5828	RAE
531	3	5831	REVERSAL
532	3	5834	THREEPOINT
533	3	5837	LIMIT
534	3	5840	LIGHT
535	3	5843	LEEWARD
536	3	5846	RADIUS

TABLE.--continued (5)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
537	3	5849	LARGE
538	3	5852	LATITUDE
539	3	5855	LATERAL
540	3	5858	YAW
541	3	5861	WIRE
542	3	5864	TORSIONAL
543	3	5867	TRANSPORT
544	3	5870	VALUE
545	3	5873	VANISHING
546	3	5876	TWIST
547	2	5878	LIEBMAN
548	2	5880	PERFECT
549	2	5882	THROUGH
550	2	5884	RECIPROCAL
551	2	5886	LIFETIME
552	2	5888	PROPELLER
553	2	5890	LIQUID
554	2	5892	MATCHING
555	2	5894	SIDE
556	2	5896	MANOEUVRE
557	2	5898	RANDOM
558	2	5900	TRANSFORMATION
559	2	5902	MARGIN
560	2	5904	PROPELLANTS
561	2	5906	RADIATIVE
562	2	5908	TRANSLATION
563	2	5910	PERCENTAGE
564	2	5912	LYAPUNOV
565	2	5914	PIVOTAL
566	2	5916	NONSTATIONARY
567	2	5918	NONSTEADY
568	2	5920	THICKENING
569	2	5922	OUTER
570	2	5924	RETROROCKET
571	2	5926	TRIM
572	2	5928	SHIELD
573	2	5930	OBSERVATION
574	2	5932	TUMBLING
575	2	5934	OBLIQUE
576	2	5936	OGIVE
577	2	5938	SHEET
578	2	5940	RICHARDSON
579	2	5942	ONE
580	2	5944	OPEN
581	2	5946	RAREFIED
582	2	5948	ORDER
583	2	5950	TWISTED
584	2	5952	KNEE
585	2	5954	KIRSCHHOFF

TABLE.--continued (6)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
586	2	5956	KINETIC
587	2	5958	KILOMETRE
588	2	5960	KERNEL
589	2	5962	KELVIN
590	2	5964	TERMINAL
591	2	5966	INVERSION
592	2	5968	INTERSECTING
593	2	5970	TENSION
594	2	5972	INTERNAL
595	2	5974	INTERFACE
596	2	5976	INNER
597	2	5978	TEFLON
598	2	5980	NEAR
599	2	5982	NAVIER
600	2	5984	TECHNIQUE
601	2	5986	NET
602	2	5988	SINK
603	2	5990	UNSWEPT
604	2	5992	MODAL
605	2	5994	TAPERED
606	2	5996	NATURAL
607	2	5998	NARROW
608	2	6000	MULTISTAGE
609	2	6002	UPWASH
610	2	6004	MOVEMENT
611	2	6006	SHADOWGRAPH
612	2	6008	MOLECULE
613	2	6010	PIVOT
614	2	6012	MECHANICS
615	2	6014	MEAN
616	2	6016	MEYER
617	2	6018	MERIDIONAL
618	2	6020	MERGED
619	2	6022	PRIMARY
620	2	6024	EXCESS
621	2	6026	SLAB
622	2	6028	ETHYLENE
623	2	6030	ESCAPE
624	2	6032	EQUIVALENT
625	2	6034	FACED
626	2	6036	EXTENSION
627	2	6038	EXPOSED
628	2	6040	REACTING
629	2	6042	FIRST
630	2	6044	FILAMENT
631	2	6046	VISCID
632	2	6048	FLAME
633	2	6050	FIXED

TABLE.--continued (7)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
634	2	6052	FLEXIBLE
635	2	6054	QUASI
636	2	6056	ROLL
637	2	6058	VORTICES
638	2	6060	PHOTOGRAPHIC
639	2	6062	PENETRATING
640	2	6064	FLUCTUATION
641	2	6066	GLIDE
642	2	6068	TAB
643	2	6070	GENERATED
644	2	6072	FUEL
645	2	6074	FRONT
646	2	6076	FREEZING
647	2	6078	SYMMETRIC
648	2	6080	SWEPTFORWARD
649	2	6082	FOURIER
650	2	6084	FORCED
651	2	6086	FOLDING
652	2	6088	WIDE
653	2	6090	ENTERING
654	2	6092	EMISSIVITY
655	2	6094	WINDWARD
656	2	6096	ELLIPTICAL
657	2	6098	WINGED
658	2	6100	ELEMENT
659	2	6102	DISTRIBUTED
660	2	6104	SLOWLY
661	2	6106	DIVERGING
662	2	6108	DIURNAL
663	2	6110	YAWED
664	2	6112	QUASICONICAL
665	2	6114	DISK
666	2	6116	ZONE
667	2	6118	ELECTRICALLY
668	2	6120	SODIUM
669	2	6122	DOUBLET
670	2	6124	SUPPORT
671	2	6126	PROCESS
672	2	6128	INCLINATION
673	2	6130	INCIPIENT
674	2	6132	INCONEL
675	2	6134	SUPERPOSITION
676	2	6136	GROUND
677	2	6138	GROSS
678	2	6140	HEATED
679	2	6142	GUIDE
680	2	6144	ROTARY
681	2	6146	HARMONICALLY
682	2	6148	HYDRODYNAMIC

TABLE.--continued (8)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
683	2	6150	SPACING
684	2	6152	HYSTERESIS
685	2	6154	HYPERVELOCITY
686	2	6156	HIGHLY
687	2	6158	HOMOGENEOUS
688	2	6160	DIFFERENTIALLY
689	2	6162	DIRECTIONAL
690	2	6164	PROGRESSIVE
691	2	6166	CURVED
692	2	6168	DEFLECTED
693	2	6170	REMOVAL
694	2	6172	DEVIATION
695	2	6174	SECTIONAL
696	2	6176	DEVELOPED
697	2	6178	RESONANCE
698	2	6180	SPECTRA
699	2	6182	SECONDORDER
700	2	6184	COPPER
701	2	6186	CRITICAL
702	2	6188	COUETTE
703	2	6190	CONCAVE
704	2	6192	COMPONENT
705	2	6194	SECOND
706	2	6196	SEASON
707	2	6198	PUMP
708	2	6200	SPHERICALLY
709	2	6202	COMBINATION
710	2	6204	COLLISION
711	2	6206	COLD
712	2	6208	PREWHIRL
713	2	6210	CHAMBER
714	2	6212	PERIODIC
715	2	6214	STARTING
716	2	6216	BUMP
717	2	6218	BUZZ
718	2	6220	BURNED
719	2	6222	CASCADE
720	2	6224	CARBON
721	2	6226	BALLISTIC
722	2	6228	ROW
723	2	6230	PROPULSION
724	2	6232	AUGMENTATION
725	2	6234	ATTENUATION
726	2	6236	ATTACHMENT
727	2	6238	AVERAGE
728	2	6240	STALLED
729	2	6242	BLOWDOWN
730	2	6244	BLEED

TABLE.--continued (9)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
731	2	6246	ATOMIC
732	2	6248	PLATES
733	2	6250	POHLHAUSEN
734	2	6252	ARTIFICIAL
735	2	6254	BEAM
736	2	6256	BETWEEN
737	2	6258	APPLIED
738	2	6260	APOGEE
739	2	6262	ADJACENT
740	2	6264	AHEAD
741	2	6266	PRESCRIBED
742	2	6268	PERPENDICULARLY
743	2	6270	STACKING
744	2	6272	AMOUNT
745	2	6274	STABLE
746	1	6275	SAIL
747	1	6276	POLYMER
748	1	6277	ANALOGY
749	1	6278	AMPLITUDE
750	1	6279	ALUMINUM
751	1	6280	PHOTORECORDING
752	1	6281	AIRSPEED
753	1	6282	AILERON
754	1	6283	PRECIPITATION
755	1	6284	ALTERNATING
756	1	6285	ALLOY
757	1	6286	ALLMOVABLE
758	1	6287	AEROELASTICITY
759	1	6288	ADVERSE
760	1	6289	SAFETY
761	1	6290	AEROTHERMODYNAMIC
762	1	6291	AEROPLANE
763	1	6292	ADJUSTABLE
764	1	6293	ADDITION
765	1	6294	ACTUAL
766	1	6295	ACTIVITY
767	1	6296	ACTIVE
768	1	6297	ACOUSTIC
769	1	6298	APPARENT
770	1	6299	APPARATUS
771	1	6300	APEX
772	1	6301	APPROACHING
773	1	6302	APPROACH
774	1	6303	APPEARANCE
775	1	6304	STAGGER
776	1	6305	RUNNING
777	1	6306	RECORD
778	1	6307	RADIATOR
779	1	6308	ANTISYMMETRIC
780	1	6309	ANNULUS

TABLE.--continued (10)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
781	1	6310	ANEMOMETER
782	1	6311	SQUARE
783	1	6312	ABOVE
784	1	6313	ABOUT
785	1	6314	ABLATING
786	1	6315	SANDPAPER
787	1	6316	ACCURATE
788	1	6317	ACCOMMODATION
789	1	6318	ACCELERATING
790	1	6319	SALT
791	1	6320	PAST
792	1	6321	PASSING
793	1	6322	PARTITION
794	1	6323	RADIOACTIVE
795	1	6324	PEAKY
796	1	6325	PEAK
797	1	6326	PAY
798	1	6327	PENDULUM
799	1	6328	PENALTY
800	1	6329	PECLET
801	1	6330	ABEL
802	1	6331	ACCELERATED
803	1	6332	ABSORPTION
804	1	6333	ABSOLUTE
805	1	6334	ABRUPT
806	1	6335	BIPLANE
807	1	6336	BIOT
808	1	6337	BENEATH
809	1	6338	ROUTINE
810	1	6339	BEAD
811	1	6340	BASIC
812	1	6341	STAGGERED
813	1	6342	ROUNDINGOFF
814	1	6343	RESEARCH
815	1	6344	BELT
816	1	6345	BANGBANG
817	1	6346	BAND
818	1	6347	BALSA
819	1	6348	BALLOTINI
820	1	6349	ASSOCIATED
821	1	6350	ARROW
822	1	6351	RUDDER
823	1	6352	ATLAS
824	1	6353	ASYMMETRIC
825	1	6354	SPOILER
826	1	6355	RULE
827	1	6356	ATOM
828	1	6357	ARRANGEMENTS
829	1	6358	ARGON

TABLE.--continued (11)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
830	1	6359	ARDC
831	1	6360	SATURATION
832	1	6361	STANDARD
833	1	6362	ROUNDED
834	1	6363	RESERVOIR
835	1	6364	BLUNTING
836	1	6365	SPLITTER
837	1	6366	PROLATE
838	1	6367	BIRNBAUM
839	1	6368	BLUFF
840	1	6369	BLOWN
841	1	6370	BLOWER
842	1	6371	AVRO
843	1	6372	AUTOPILOT
844	1	6373	AUTOMATIC
845	1	6374	PICKUP
846	1	6375	ROUTTHURWITZ
847	1	6376	AXIALLY
848	1	6377	BAFFLES
849	1	6378	BACK
850	1	6379	CARBORUNDUM
851	1	6380	CAPTURE
852	1	6381	CAPACITY
853	1	6382	CENTIMETRE
854	1	6383	CENTERING
855	1	6384	CARRYING
856	1	6385	SPIN
857	1	6386	PERPENDICULAR
858	1	6387	CAMBERED
859	1	6388	CALCULATING
860	1	6389	CAPACITANCE
861	1	6390	CAPABILITY
862	1	6391	CANTELEVERED
863	1	6392	CANTELEVER
864	1	6393	BURSTING
865	1	6394	BUOYANCY
866	1	6395	BUFFET
867	1	6396	BUCKLING
868	1	6397	SPIKED
869	1	6398	BREATHING
870	1	6399	BRADING
871	1	6400	BOUND
872	1	6401	BOOST
873	1	6402	STATICALLY
874	1	6403	SCHLICHTING
875	1	6404	SPIKE
876	1	6405	CHLORIDE
877	1	6406	CHARGED

TABLE.--continued (12)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
878	1	6407	SPHEROID
879	1	6408	PRODUCTION
880	1	6409	CESSATION
881	1	6410	CENTRAL
882	1	6411	SCAVENGING
883	1	6412	SCALING
884	1	6413	RESISTANCE
885	1	6414	CHOKE
886	1	6415	STATOR
887	1	6416	CLASSICAL
888	1	6417	CIRCUMFERENTIAL
889	1	6418	CIRCULATORY
890	1	6419	STATISTICAL
891	1	6420	COCURRENT
892	1	6421	CLIPPED
893	1	6422	PROXIMITY
894	1	6423	POUND
895	1	6424	CIRCULATING
896	1	6425	CIRCUIT
897	1	6426	STEEL
898	1	6427	RELIABILITY
899	1	6428	CONDUCTING
900	1	6429	STIFFENER
901	1	6430	CONSTRAINT
902	1	6431	CONSERVATION
903	1	6432	STEP
904	1	6433	RESONANT
905	1	6434	PURE
906	1	6435	CONICALLY
907	1	6436	CONDENSATION
908	1	6437	CONCENTRIC
909	1	6438	CONCENTRATION
910	1	6439	CONCENTRATED
911	1	6440	CONTINUITY
912	1	6441	CONTINUATION
913	1	6442	CONTACT
914	1	6443	STORES
915	1	6444	STORE
916	1	6445	STOICHIOMETRIC
917	1	6446	CONTRACTING
918	1	6447	STING
919	1	6448	STILL
920	1	6449	PLUNGING
921	1	6450	CONTROLLING
922	1	6451	CONTRIBUTION
923	1	6452	SPECTRUM
924	1	6453	SEASONAL
925	1	6454	COMPRESSED

TABLE.--continued (13)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
926	1	6455	STRATFORD
927	1	6456	SECONDARY
928	1	6457	COMPOSED
929	1	6458	QUALITY
930	1	6459	COMPUTATION
931	1	6460	COMPREG
932	1	6461	COMPOUND
933	1	6462	COMPOSITION
934	1	6463	COMPOSITE
935	1	6464	COUNTERROTATING
936	1	6465	COUNTERCURRENT
937	1	6466	CORRELATED
938	1	6467	CRITERION
939	1	6468	COUPON
940	1	6469	COUPLED
941	1	6470	SPECIMEN
942	1	6471	COROTATING
943	1	6472	STREAMS
944	1	6473	COOLED
945	1	6474	DIETZE
946	1	6475	DIATOMIC
947	1	6476	STREAMTUBE
948	1	6477	DIAPHRAGM
949	1	6478	RAW
950	1	6479	DESTABILIZING
951	1	6480	DERIVATION
952	1	6481	SELECTED
953	1	6482	PROJECTION
954	1	6483	DEFICIENCY
955	1	6484	STREET
956	1	6485	PROTECTION
957	1	6486	DAYTIME
958	1	6487	DAYTONIGHT
959	1	6488	SPECIES
960	1	6489	DECREASE
961	1	6490	DECELERATING
962	1	6491	DECAYING
963	1	6492	SPANNING
964	1	6493	PITCHUP
965	1	6494	DELAY
966	1	6495	REMOVED
967	1	6496	QUARTZ
968	1	6497	CYCLES
969	1	6498	POWELL
970	1	6499	DAMPOMETER
971	1	6500	SEEDED
972	1	6501	CROSSED
973	1	6502	CROSSECTION
974	1	6503	CROPPED

TABLE.--continued (14)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
975	1	6504	CURRENT
976	1	6505	CRUISING
977	1	6506	CROSSING
978	1	6507	CROSSFLOW
979	1	6508	STRINGER
980	1	6509	DIRECTION
981	1	6510	DIFFUSION
982	1	6511	DIFFUSER
983	1	6512	DISEQUILIBRIUM
984	1	6513	DISCRETE
985	1	6514	DISCOVER
986	1	6515	DISCONTINUOUS
987	1	6516	DIRECT
988	1	6517	DIOXIDE
989	1	6518	DIMENSIONLESS
990	1	6519	DIMENSION
991	1	6520	HORIZONTAL
992	1	6521	HOLE
993	1	6522	HOLDING
994	1	6523	HINGED
995	1	6524	SUBJECTED
996	1	6525	HEXACHLORETHANE
997	1	6526	HEMISPHERICALLY
998	1	6527	RELEASE
999	1	6528	HELMHOLZ
1000	1	6529	HEAVY
1001	1	6530	SELFINDUCED
1002	1	6531	SELF
1003	1	6532	SUBSTANTIAL
1004	1	6533	IGNITED
1005	1	6534	IDEALIZED
1006	1	6535	SUDDEN
1007	1	6536	HYDROCARBON
1008	1	6537	HUMIDITY
1009	1	6538	SEMIELLIPSOID
1010	1	6539	HUGONOIT
1011	1	6540	HARTMANN
1012	1	6541	HANDLING
1013	1	6542	GYROSCOPIC
1014	1	6543	GUN
1015	1	6544	SUN
1016	1	6545	SOUNDING
1017	1	6546	PROMOTION
1018	1	6547	GREEN
1019	1	6548	PRACTICAL
1020	1	6549	INCREASED
1021	1	6550	INCLINED
1022	1	6551	INCIDENT

TABLE.--continued (15)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
1023	1	6552	INBOARD
1024	1	6553	IN
1025	1	6554	IMPROVED
1026	1	6555	SUPERSATELLITE
1027	1	6556	INDICATOR
1028	1	6557	INCREMENT
1029	1	6558	INCREASING
1030	1	6559	DUE
1031	1	6560	DRY
1032	1	6561	DROOP
1033	1	6562	SUPPORTED
1034	1	6563	DOMAIN
1035	1	6564	DIVISION
1036	1	6565	RELATIONSHIP
1037	1	6566	PERFORATED
1038	1	6567	DRIERS
1039	1	6568	DRIVEN
1040	1	6569	DRIVE
1041	1	6570	DRILLING
1042	1	6571	DRILLED
1043	1	6572	SOFT
1044	1	6573	EIGENVALVE
1045	1	6574	ELECTRIC
1046	1	6575	SUPPORTING
1047	1	6576	ROOM
1048	1	6577	ROOFTOP
1049	1	6578	SENSOR
1050	1	6579	PILOTING
1051	1	6580	PHUGOID
1052	1	6581	DISSIPATIVE
1053	1	6582	DISPLACED
1054	1	6583	YAWING
1055	1	6584	WOOD
1056	1	6585	SLUG
1057	1	6586	RESTART
1058	1	6587	DISTORTION
1059	1	6588	SMOOTH
1060	1	6589	REST
1061	1	6590	WITHIN
1062	1	6591	ELEMENTARY
1063	1	6592	ELECTROMAGNETICAL
1064	1	6593	ELECTROMAGNETIC
1065	1	6594	END
1066	1	6595	EMITTED
1067	1	6596	SEMIVERTEX
1068	1	6597	PRODUCT
1069	1	6598	ELIMINATION
1070	1	6599	ELEVON
1071	1	6600	ELEVATED

TABLE.--continued (16)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
1072	1	6601	WHIRL
1073	1	6602	PHOTOMULTIPLIER
1074	1	6603	FORCING
1075	1	6604	WEISSINGER
1076	1	6605	POLYGON
1077	1	6606	RESULTANT
1078	1	6607	WEAKENING
1079	1	6608	FREESTREAM
1080	1	6609	FREEENTERING
1081	1	6610	WAVELENGTH
1082	1	6611	SLIPSTREAM
1083	1	6612	FRICTIONLESS
1084	1	6613	SETTING
1085	1	6614	PROPAGATION
1086	1	6615	FREON
1087	1	6616	SLIGHTLY
1088	1	6617	POLAR
1089	1	6618	FUSED
1090	1	6619	PLASTIC
1091	1	6620	GEAR
1092	1	6621	GAUGE
1093	1	6622	FUSION
1094	1	6623	WATER
1095	1	6624	SYSTEMATIC
1096	1	6625	SERVO
1097	1	6626	GENERAL
1098	1	6627	WARREN12
1099	1	6628	RETARDING
1100	1	6629	GRAPHICAL
1101	1	6630	GRAIN
1102	1	6631	WARD
1103	1	6632	TABULATION
1104	1	6633	GLASS
1105	1	6634	GIVEN
1106	1	6635	ROD
1107	1	6636	GRAVITATIONAL
1108	1	6637	GRATE
1109	1	6638	PROPAGATING
1110	1	6639	FLOWMETER
1111	1	6640	WAGNER
1112	1	6641	FLARE
1113	1	6642	FLAPPING
1114	1	6643	PORTION
1115	1	6644	FLUTTERING
1116	1	6645	VONKARMAN
1117	1	6646	TAILBOOM
1118	1	6647	FLEXURE
1119	1	6648	FLEXURAL

TABLE.--continued (17)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
1120	1	6649	VOLUME
1121	1	6650	FIVESTAGE
1122	1	6651	FISSION
1123	1	6652	PRINCIPLE
1124	1	6653	FILTER
1125	1	6654	FILLING
1126	1	6655	VIBRATIONALLY
1127	1	6656	VIBRATIONAL
1128	1	6657	FIRING
1129	1	6658	FINAL
1130	1	6659	FEEDBACK
1131	1	6660	FAST
1132	1	6661	FAR
1133	1	6662	FALL
1134	1	6663	EXPRESSION
1135	1	6664	EXPONENTIAL
1136	1	6665	EXPONENT
1137	1	6666	VERY
1138	1	6667	SEVERELY
1139	1	6668	EXTERNALLY
1140	1	6669	EXTENT
1141	1	6670	EXTREME
1142	1	6671	EXTRAPOLATED
1143	1	6672	SIX
1144	1	6673	FAIR
1145	1	6674	FAILURE
1146	1	6675	FAHRENHEIT
1147	1	6676	VENTURIS
1148	1	6677	ERROR
1149	1	6678	EROSION
1150	1	6679	EQUIVALENCE
1151	1	6680	SKIP
1152	1	6681	ESTIMATE
1153	1	6682	PROCEDURE
1154	1	6683	EQUIPMENT
1155	1	6684	EQUATORIAL
1156	1	6685	SKEWED
1157	1	6686	SEVERE
1158	1	6687	ENVIRONMENTAL
1159	1	6688	ENTRANCE
1160	1	6689	EXOTHERMIC
1161	1	6690	EXITING
1162	1	6691	VARIATIONAL
1163	1	6692	TAILLESS
1164	1	6693	RELAY
1165	1	6694	EXCITED
1166	1	6695	TAILPLANE
1167	1	6696	POSITIVE

TABLE.--continued (18)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
1168	1	6697	EXACT
1169	1	6698	EVAPORATION
1170	1	6699	EVAPORATING
1171	1	6700	EVALUATION
1172	1	6701	VAPOURIZATION
1173	1	6702	MESH
1174	1	6703	MEDIUM
1175	1	6704	VAPOUR
1176	1	6705	MIDDLE
1177	1	6706	MIDCOURSE
1178	1	6707	MIDAS
1179	1	6708	VANGUARD
1180	1	6709	PIPE
1181	1	6710	MECHANISM
1182	1	6711	METHANE
1183	1	6712	METEROID
1184	1	6713	METEORITE
1185	1	6714	VANELESS
1186	1	6715	POINTED
1187	1	6716	MOUNTED
1188	1	6717	VALUED
1189	1	6718	MOLYBDENUM
1190	1	6719	MOL
1191	1	6720	VACUUM
1192	1	6721	TAP
1193	1	6722	TANGENT
1194	1	6723	UPRATING
1195	1	6724	UNWIND
1196	1	6725	UNTAPERED
1197	1	6726	TAPPING
1198	1	6727	PINE
1199	1	6728	TARGET
1200	1	6729	REDUCTED
1201	1	6730	REDUCED
1202	1	6731	MISSION
1203	1	6732	MOISTURE
1204	1	6733	MODULUS
1205	1	6734	MODERATE
1206	1	6735	MINOR
1207	1	6736	MINIMUM
1208	1	6737	MILES
1209	1	6738	MILD
1210	1	6739	UNSTALLING
1211	1	6740	NEUTRAL
1212	1	6741	NEARTRIANGULAR
1213	1	6742	UNSTALLED
1214	1	6743	UNITY
1215	1	6744	UNIT
1216	1	6745	NAUTICAL

TABLE.--continued (19)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
1217	1	6746	TAYLOR
1218	1	6747	SINGLY
1219	1	6748	SHAPED
1220	1	6749	NIGHTTIME
1221	1	6750	SINGULAR
1222	1	6751	NONCATALYTIC
1223	1	6752	NONABLATING
1224	1	6753	NOLIFT
1225	1	6754	INSULATED
1226	1	6755	INSTRUMENTATION
1227	1	6756	INSTABILITY
1228	1	6757	UNIDIRECTIONAL
1229	1	6758	POSSION
1230	1	6759	INTERIOR
1231	1	6760	UNHEATED
1232	1	6761	TELEMETERING
1233	1	6762	INTERNALLY
1234	1	6763	INTERJECTORY
1235	1	6764	REGRESSION
1236	1	6765	INTEGRATING
1237	1	6766	INTAKE
1238	1	6767	UNFOLDING
1239	1	6768	INJECTION
1240	1	6769	INJECTED
1241	1	6770	INITIATED
1242	1	6771	INITIALLY
1243	1	6772	INFINITESIMALLY
1244	1	6773	RIGIDITY
1245	1	6774	INFINITELY
1246	1	6775	INEXORABLE
1247	1	6776	INERTIA
1248	1	6777	RIEMANN
1249	1	6778	POSTBUCKLING
1250	1	6779	INDIVIDUAL
1251	1	6780	INDIRECT
1252	1	6781	UNDISSOCIATED
1253	1	6782	UNDERWATER
1254	1	6783	INTERPLANETARY
1255	1	6784	UNCOUPLED
1256	1	6785	ISOBAR
1257	1	6786	IRROTATIONAL
1258	1	6787	RIGIDLY
1259	1	6788	ION
1260	1	6789	IODIDE
1261	1	6790	ISOTROPIC
1262	1	6791	ISOTOPE
1263	1	6792	ISOENERGETIC
1264	1	6793	ISOBARIC
1265	1	6794	UNCAMBERED

TABLE.--continued (20)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
1266	1	6795	UNBOUNDED
1267	1	6796	ULTRAVIOLET
1268	1	6797	TWODIMENSIONS
1269	1	6798	KUSSNER
1270	1	6799	KINK
1271	1	6800	THEODORSEN
1272	1	6801	JEFFERYHAMEL
1273	1	6802	ISSUING
1274	1	6803	KARMAN
1275	1	6804	JUMO
1276	1	6805	JOUKOWSKI
1277	1	6806	JOHANNESEN
1278	1	6807	ORDINATE
1279	1	6808	TURNING
1280	1	6809	OPTIMUM
1281	1	6810	OPTIMIZATION
1282	1	6811	THEOREM
1283	1	6812	REARWARD
1284	1	6813	RANKLINE
1285	1	6814	OSCILLOGRAPH
1286	1	6815	ORTHOGONAL
1287	1	6816	ORIGINATING
1288	1	6817	ORIFICE
1289	1	6818	ORIENTATION
1290	1	6819	TURBULENCE
1291	1	6820	TURBOMACHINE
1292	1	6821	ONEDIMENSION
1293	1	6822	SIMPLY
1294	1	6823	OILFLOW
1295	1	6824	OCTAGONAL
1296	1	6825	TUNGSTEN
1297	1	6826	OBLATENESS
1298	1	6827	SIMPLE
1299	1	6828	NUCLEAR
1300	1	6829	NPL
1301	1	6830	OVERRELAXATION
1302	1	6831	OVEREXPANDED
1303	1	6832	OVERALL
1304	1	6833	TRUNCATED
1305	1	6834	SIMILITUDE
1306	1	6835	PAIR
1307	1	6836	TRIANGLE
1308	1	6837	THICKENED
1309	1	6838	OUTFLOW
1310	1	6839	THERMALLY
1311	1	6840	SIMILARITY
1312	1	6841	TRAVERSE
1313	1	6842	SHIELDING
1314	1	6843	REFERENCE

TABLE.--continued (21)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
1315	1	6844	TRAVELLING
1316	1	6845	NONPERFECT
1317	1	6846	NONPARALLEL
1318	1	6847	TRANSVERSE
1319	1	6848	NOTSOSLENDER
1320	1	6849	NOSEPIECE
1321	1	6850	SILICA
1322	1	6851	SHORT
1323	1	6852	NONDISSIPATIVE
1324	1	6853	NONDISSIPATING
1325	1	6854	TRANSPIRATION
1326	1	6855	MAGNESIUM
1327	1	6856	LUNISOLAR
1328	1	6857	SIDEWASH
1329	1	6858	LORENZ
1330	1	6859	THREE
1331	1	6860	LUMINOUS
1332	1	6861	LUMINOSITY
1333	1	6862	POISEUILLE
1334	1	6863	LOCKHEED
1335	1	6864	LOCALLY
1336	1	6865	MARTIAN
1337	1	6866	MANOMETER
1338	1	6867	TRANSFORMATION
1339	1	6868	MAJOR
1340	1	6869	MAGNITUDE
1341	1	6870	RAMP
1342	1	6871	MATRIX
1343	1	6872	MAGNIFICATION
1344	1	6873	MAGNETOPLASMA
1345	1	6874	MAGNETOFLUIDMECH
1346	1	6875	MAGNETIC
1347	1	6876	TRAJECTORIES
1348	1	6877	PROPELLED
1349	1	6878	LOADED
1350	1	6879	TORSO
1351	1	6880	REVERSED
1352	1	6881	LIFE
1353	1	6882	REVERSIBILITY
1354	1	6883	LIQUIFACTION
1355	1	6884	LINERS
1356	1	6885	LINEARIZATION
1357	1	6886	TORQUE
1358	1	6887	THWAITES
1359	1	6888	REENTRANT
1360	1	6889	LEAD
1361	1	6890	TOLLMENSCHLICHT
1362	1	6891	LIBRATION

TABLE.--continued (22)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
1363	1	6892	LESS
1364	1	6893	TOLLMIEN
1365	1	6894	LAW
1366	1	6895	LATERALLY
1367	1	6896	TIMEOPTIMUM
1368	1	6897	PLANET
1369	1	6898	LAMINARIZATION
1370	1	6899	L-METHOD

APPENDIX F

SMALL DOCUMENT FILE

APPENDIX G

TABLES AND FIGURES

TABLE 1

DEPTH, BREADTH AND POSTING STATISTICS FOR DELETION OF TERM QUARTILES

DELETION	AVERAGE BREADTH	AVERAGE DEPTH	POSTINGS	DIFFERENT TERMS POSTED	AVERAGE BREADTH OF TERMS DELETED
No Deletion	2.17	34.49	6899	1370	
1st Quartile	1.63	25.87	5173	1337	52.12
2nd Quartile	1.63	25.86	5170	1285	20.34
3rd Quartile	1.63	25.88	5176	1147	7.72
4th Quartile	1.63	25.89	5178	341	1.72

TABLE 2

DELETION OF TERM QUARTILES: RECALL MEANS AND STANDARD ERRORS

CUTOFF	1		2		3		4		5	
DELETION	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
No	0.96	0.0139	0.83	0.0375	0.64	0.0497	0.43	0.0607	0.22	0.0480
1st Quartile	0.82	0.0326	0.52	0.0558	0.28	0.0512	0.16	0.0479	0.04	0.0198
2nd Quartile	0.87	0.0364	0.71	0.0538	0.44	0.0596	0.24	0.0503	0.08	0.0302
3rd Quartile	0.92	0.0285	0.72	0.0480	0.52	0.0608	0.31	0.0571	0.12	0.0388
4th Quartile	0.96	0.0105	0.82	0.0256	0.53	0.0395	0.32	0.0375	0.12	0.0274

Cutoff is the number of terms a document must have in common with a search question to be considered retrieved.

TABLE 3

DELETION OF TERM QUARTILES: PRECISION MEANS AND STANDARD ERRORS

CUTOFF	1		2		3		4		5	
DELETION	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
No	0.05	0.0077	0.17	0.0357	0.33	0.0536	0.48	0.0585	0.55	0.0829
1st Quartile	0.11	0.0141	0.36	0.0493	0.71	0.0568	0.90	0.0617	0.81	0.0931
2nd Quartile	0.08	0.0255	0.22	0.0429	0.36	0.0620	0.66	0.0876	0.66	0.1086
3rd Quartile	0.07	0.0234	0.18	0.0419	0.29	0.0551	0.42	0.0771	0.51	0.1066
4th Quartile	0.05	0.0080	0.17	0.0352	0.30	0.0566	0.44	0.0760	0.37	0.0479

Cutoff is the number of terms a document must have in common with a search question to be considered retrieved.

TABLE 4

DELETION OF TERM QUARTILES: PRECISION AND RECALL

CUTOFF / DELETION	1		2		3		4		5	
	P	R	P	R	P	R	P	R	P	R
No	.05	.96	.17	.83	.33	.64	.48	.43	.55	.22
1st Quartile	.11**	.82**	.36**	.52**	.71**	.28**	.90	.16**	.81x	.04**
2nd Quartile	.08*	.87**	.22**	.71**	.36*	.44**	.66**	.24**	.66	.08**
3rd Quartile	.07	.92*	.18	.72**	.29	.52**	.42*	.31**	.51	.12**
4th Quartile	.05	.96	.17	.82	.30	.53**	.44	.32**	.37x	.12**

* Compared with no deletion the difference is significant at .05.

** Compared with no deletion the different is significant at .01.

x Sample size too small, owing to indeterminate changes in precision, to warrant any conclusion about significance.

Cutoff is the number of terms a document must have in common with a search question to be considered retrieved.

TABLE 5

STATISTICAL COMPARISON OF INDEXINGS OBTAINED BY DELETION OF TERM QUARTILES: RECALL

CUTOFF DELETIONS COMPARED	1	2	3	4	5
No vs. 1st	**	**	**	**	**
No vs. 2nd	**	**	**	**	**
No vs. 3rd	*	**	**	**	**
No vs. 4th			**	**	
1st vs. 2nd		*	**		
1st vs. 3rd	**	**	**	*	
1st vs. 4th	**	**	**	*	
2nd vs. 3rd					
2nd vs. 4th	**	**	*		
3rd vs. 4th		**			

* The difference is significant at .05.

** The difference is significant at .01.

Cutoff is the number of terms a document must have in common with a search question to be considered retrieved.

TABLE 6

STATISTICAL COMPARISON OF INDEXINGS OBTAINED BY DELETION OF TERM QUARTILES: PRECISION

CUTOFF DELETIONS COMPARED	1	2	3	4	5
No vs. 1st	**	**	**		x
No vs. 2nd	*	**	*	**	
No vs. 3rd				*	
No vs. 4th					x
1st vs. 2nd	**	*	**		
1st vs. 3rd	**	**			
1st vs. 4th	**	**	*		
2nd vs. 3rd					
2nd vs. 4th					
3rd vs. 4th					

* The difference is significant at .05.
** The difference is significant at .01.
x Sample size too small, owing to indeterminate changes in precision,to warrant any conclusion about significance.
Cutoff is the number of terms a document must have in common with a search question to be considered retrieved.

TABLE 7

DELETION OF TERM QUARTILES: ESL MEANS AND STANDARD ERRORS

S*	1		2		3		4		5	
DELETION	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
No	3.11	0.9304	11.76	3.5116	16.71	4.7759	35.24	8.3123	42.48	10.1508
1st Quartile	2.43	0.5286	10.67	2.8758	21.82	6.1846	47.89	9.2805	66.62	13.2676
2nd Quartile	7.58	2.9149	21.12	5.5695	28.60	6.4860	47.68	9.6960	48.38	10.0334
3rd Quartile	4.57	1.2244	16.64	4.0918	22.95	5.4234	43.56	8.7456	58.46	10.5611
4th Quartile	5.28	1.8888	12.04	3.3463	16.99	4.6077	37.86	8.3724	45.76	10.2191

S* is the number of relevant documents requested of the system.

TABLE 8

DELETION OF TERM QUARTILES: ESL

S* / DELETION	1	2	3	4	5	AVG.
No	3.11	11.76	16.71	35.24	42.48	21.86
1st Quartile	2.43	10.67	21.82	47.89	66.62*	29.89
2nd Quartile	7.58*	21.12**	28.60**	47.68	48.38	30.67
3rd Quartile	4.57	16.64*	22.95	43.56	58.46*	29.23
4th Quartile	5.28*	12.04	16.99	37.86	45.76	23.59

* Compared with no deletion the difference is significant at .05.

** Compared with no deletion the difference is significant at .01.

S* is the number of relevant documents requested of the system.

TABLE 9

STATISTICAL COMPARISON OF INDEXINGS OBTAINED BY DELETION OF TERM QUARTILES: ESL

S*	1	2	3	4	5
DELETIONS COMPARED					
No vs. 1st					*
No vs. 2nd	*	**	**		
No vs. 3rd		*			*
No vs. 4th	*				
1st vs. 2nd	*	**			
1st vs. 3rd		*			
1st vs. 4th					*
2nd vs. 3rd					
2nd vs. 4th		**	*		
3rd vs. 4th					*

* The difference is significant at .05.

** The difference is significant at .01.

Cutoff is the number of terms a document must have in common with a search question to be considered retrieved.

TABLE 10

DEPTH, BREADTH AND POSTING STATISTICS FOR DELETION OF NON-TITLE, NON-WEIGHTED-10 TERMS
(AND CORRESPONDING RANDOM DELETIONS)

DELETION	AVERAGE BREADTH	AVERAGE DEPTH	POSTINGS	DIFFERENT TERMS POSTED	AVERAGE BREADTH OF TERMS DELETED
No Deletion	2.17	34.49	6899	1370	
Non-Title	.45	7.06	1411	427	5.82
Random	.45	7.07	1414	566	6.82
Non-Weighted-10	.47	7.43	1484	545	6.49
Random	.47	7.41	1483	621	7.23

TABLE 11

DELETION OF NON-TITLE AND NON-WEIGHTED-10 TERMS
(AND CORRESPONDING RANDOM DELETIONS): RECALL MEANS AND STANDARD ERRORS

CUTOFF	1		2		3		4		5	
DELETION	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
Non-Title	0.79	0.0383	0.53	0.0561	0.26	0.0475	0.15	0.0434	0.07	0.0263
Random	0.48	0.0396	0.15	0.0366	0.03	0.0145	0.01	0.0070	0.00	0.0018
Non-Weighted-10	0.66	0.0554	0.36	0.0575	0.15	0.0459	0.07	0.0328	0.03	0.0225
Random	0.51	0.0449	0.19	0.0374	0.05	0.0220	0.02	0.0140	0.00	0.0070

Cutoff is the number of terms a document must have in common with a search question to be considered retrieved.

[illegible]E 12

DELETION OF NON-T[illegible]ND NON-WEIGHTED-10 TERMS
(AND CORRESPONDING RANDOM DELE[illegible]: PRECISION MEANS AND STANDARD ERRORS

CUTOFF	1		2		3		4		5	
DELETION	Mean	Standard Error	Mean	Standa[illegible] Erro[illegible]	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
Non-Title	0.11	0.0187	0.33	0.0648	0.65	0.0639	0.85	0.0506	0.86	0.0692
Random	0.09	0.0117	0.34	0.0589	0.42	0.0582	1.00	0.0000	1.00	0.0000
Non-Weighted-10	0.13	0.0169	0.49	0.064[illegible]	0.85	0.0660	0.95	0.0440	0.91	0.0599
Random	0.10	0.0178	0.38	0.086[illegible]	0.65	0.0779	1.00	0.0000	1.00	0.0000

Cutoff is the number of terms a document must have[illegible]mmon with a search question to be considered retrieved.

[illegible]E 13

DELETION OF NON-TI[illegible]ND NON-WEIGHTED-10 TERMS
(AND CORRESPONDING RAN[illegible]LETIONS): PRECISION AND RECALL

CUTOFF	1		2		3		4		5	
DELETION	P	R	P	R	P	R	P	R	P	R
No	.05	.96	.17	.83	.33	.64	.48	.43	.55	.22
Non-Title	.11** } **	.79** } **	.33**	.53[illegible]	.65** } *	.26** } **	.85**	.15** } **	.86*	.07** } **
Random	.09	.48**	.34**	.15[illegible]	.42**	.03**	1.00^{x}	.01**	1.00^{x}	.00**
Non-Weighted-10	.13** } *	.66** } *	.49**	.36[illegible]	.85**	.15** } *	$.95^{x}$	.07**	$.91^{x}$	.03**
Random	.10**	.51**	.38**	.19[illegible]	.65*	.05**	1.00^{x}	.02**	1.00^{x}	.00**

* Significant at .05.

** Significant at .01.

x Sample size too small to warrant any conclusion about significance.

A bracket around two values indicates that they are significantly different from each other.

Cutoff is the number of terms a document must have in common with a search question to be considered retrieved.

[illegible]E 14

DELETION OF NON-TI[illegible]ND NON-WEIGHTED-10 TERMS
(AND CORRESPONDING RANDOM DE[illegible]S): ESL MEANS AND STANDARD ERRORS

S*	1		2		3		4		5	
DELETION	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
Non-Title	4.21	1.4724	11.60	2.9720	27.10	6.7941	50.69	9.3241	67.40	12.3842
Random	14.22	3.9318	42.69	7.2501	57.11	7.3318	89.40	9.2833	105.98	9.5332
Non-Weighted-10	8.92	2.8167	24.47	5.6094	42.13	7.7877	64.79	10.2693	79.11	13.4131
Random	12.63	3.3927	38.59	6.9107	58.88	7.9756	89.77	9.6906	94.24	11.8622

S* is the number of relevant documents requested of [illegible]ystem.

E 15

LELETION OF NON-TIT ND NON-WEIGHTEL-10 TERMS
(AND CORRESPONDIN NDOM DELETIONS): ESL

S* / DELETION	1	2	3	4	5
No	3.11	11.76	16.71	35.24	42.48
Non-Title	4.21	11.60	27.10	50.69*	67.40**
Random	14.22**	42.69**	57.11**	89.40**	105.98**
Non-Weighted-10	8.92*	24.47*	42.13**	64.79**	79.11**
Random	12.63**	38.59**	58.88**	89.77 *	94.24**

* Significant at .05.

** Significant at .01

A bracket around two values indicates that
are significantly different from each other.

S* is the number of relevant documents requ of the system.

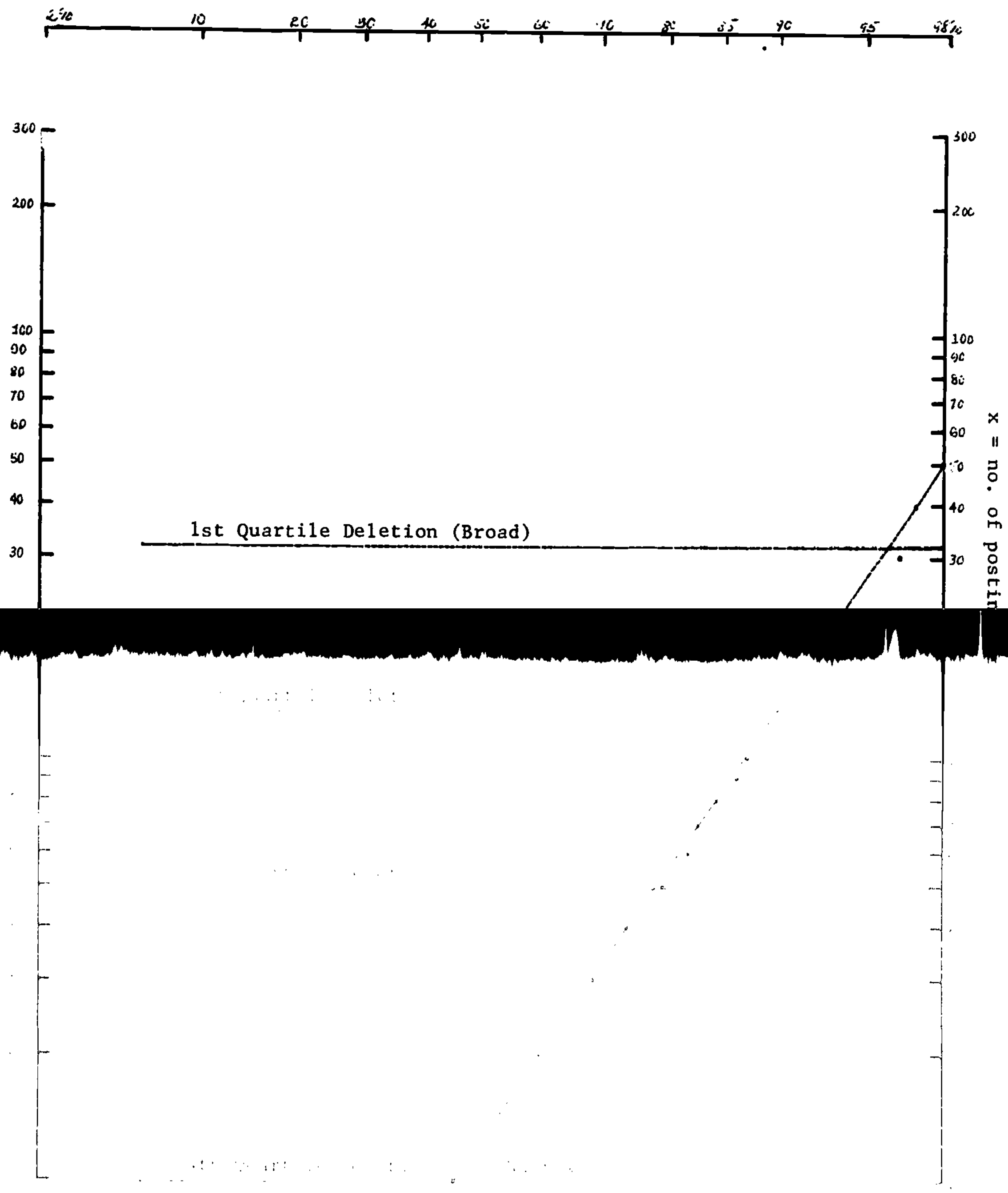
Number of Overlaps	Document Retrieved					
6	1666*	1670*	2100	2319		
5	1436	1509	1575	1576	1667*	1978
4	1302	1437	1572	1981	1983	2082
3	1324*	1378*	1383	1496	1590	1606
	1655	1656	1672	1691	1963	1980
	1988	1989	2101			
2	1360	1574	1578	1588	1596	1620
	1671	1707	1717	1737	1836	1972
	1973	1974	1982	1992	1997	2002
	2061	2077	2080	2071	2083	2153
	2157	2318				
1	1311	1316	1351	1399	1420	1476
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	1695	1701	1783	1792	1798	[illegible]
	1800	1916	1965	1966	1968	[illegible]
	1984	1986	2001	2078	2085	[illegible]
	2102	2103	2150	5187	2316	2317
	2339	2340	2342	2367		

FIG. 1

DOCUMENTS RETRIEVED IN RESPONSE TO QUESTION 118

The documents are ordered according to overlap level.
Documents relevant to the question are marked with a star (*).

S = % terms having x or fewer postings



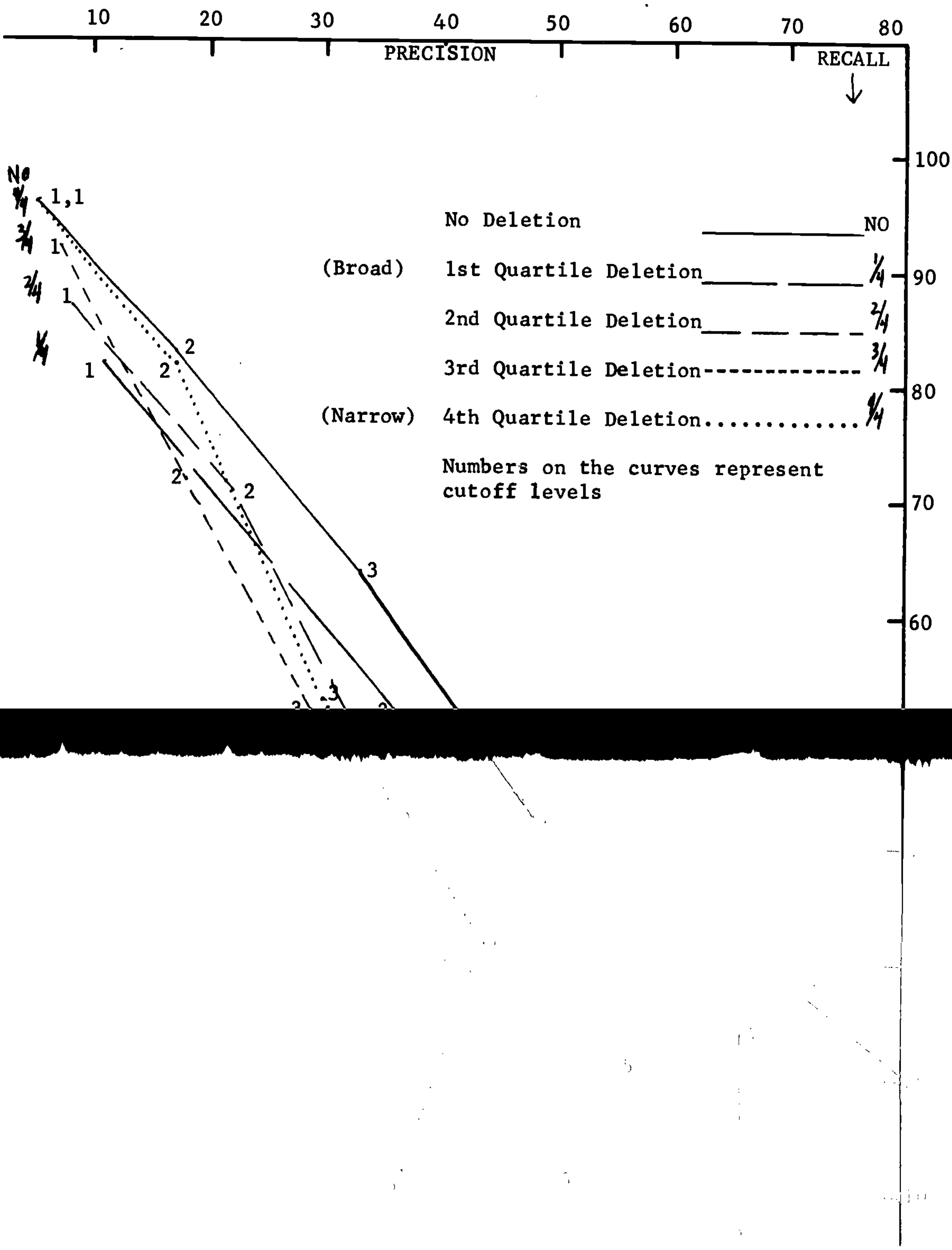
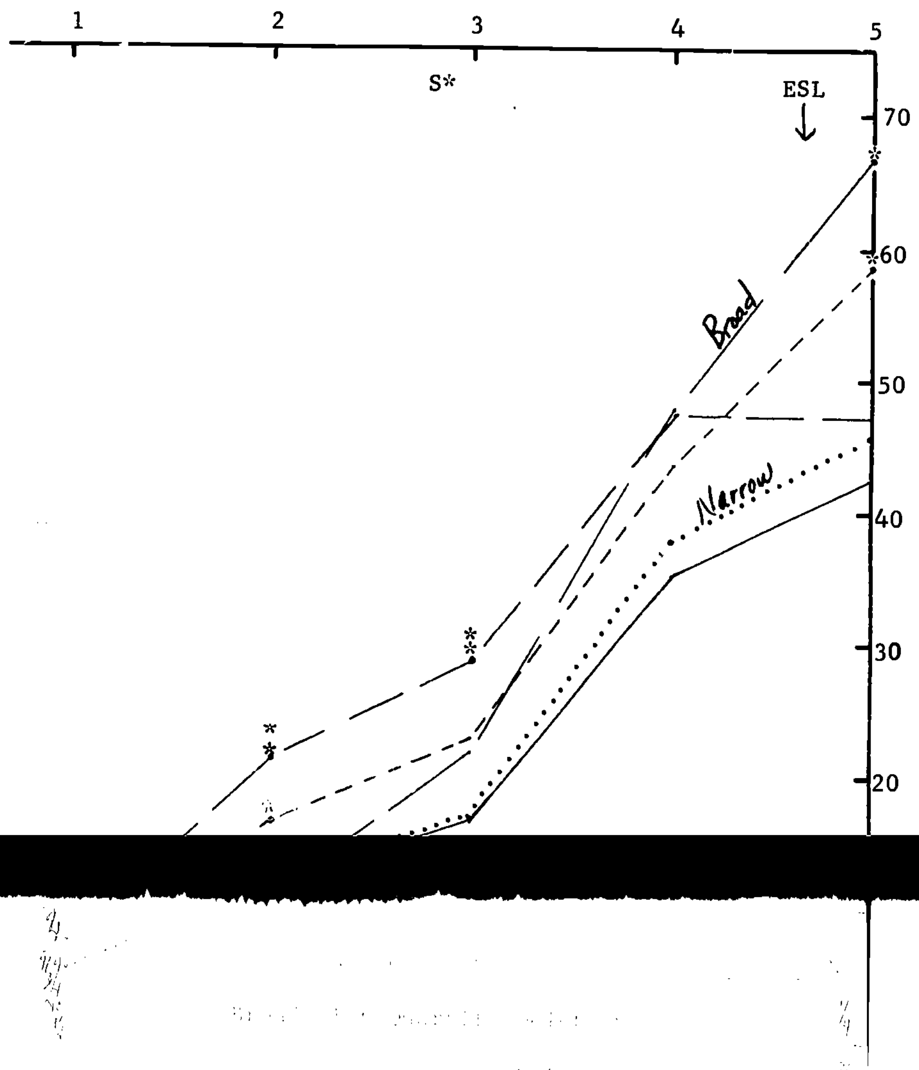


FIG. 5

DELETION OF TERM QUARTILES: PRECISION AND RECALL



Broad 4th quartile deletion

3rd quartile deletion

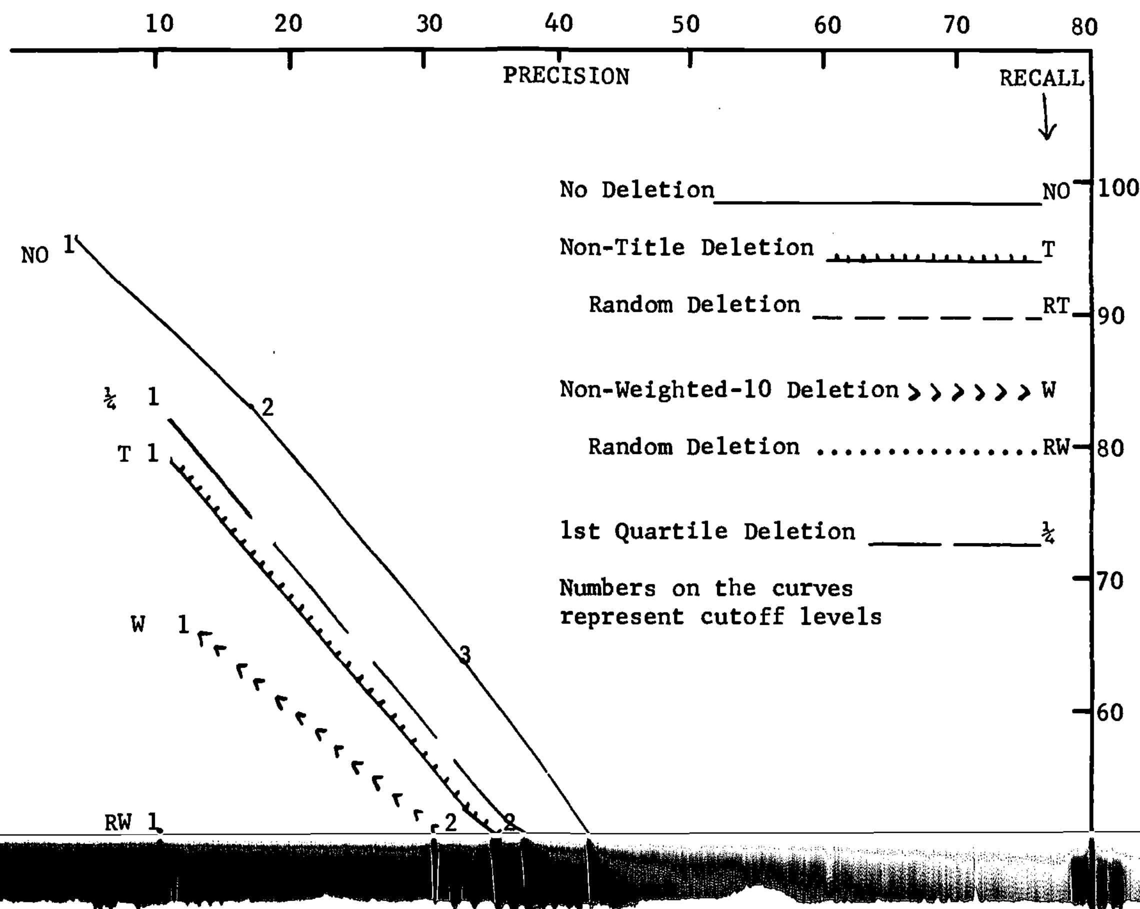
2nd quartile deletion

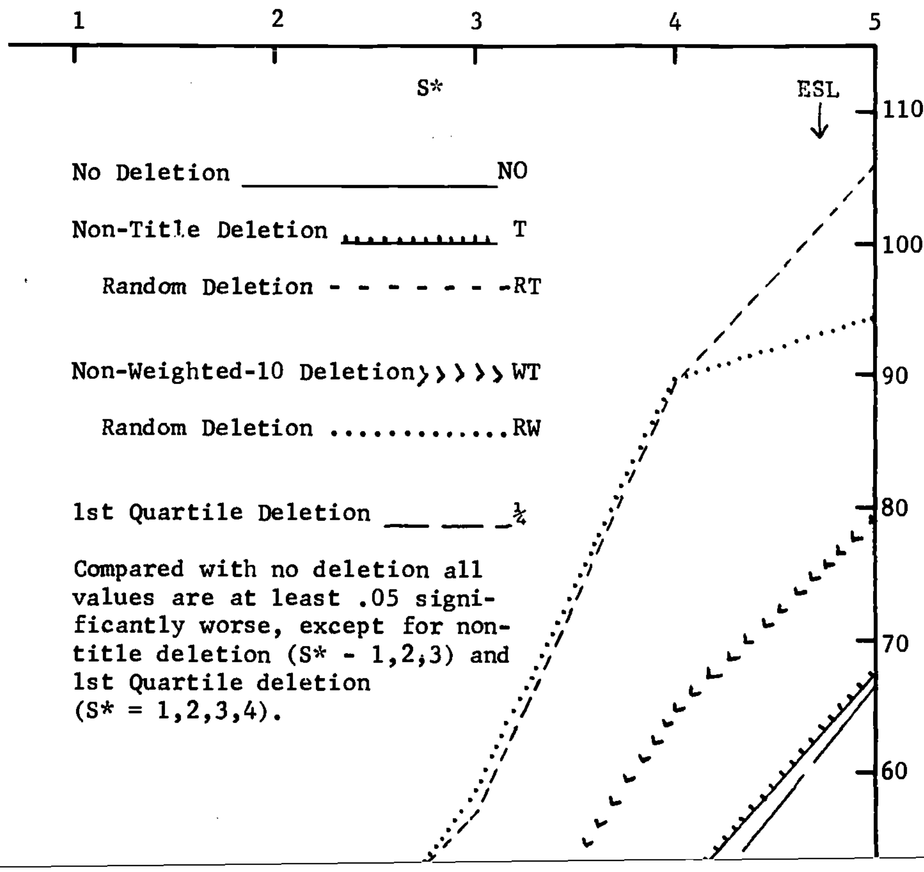
Narrow 1st quartile deletion

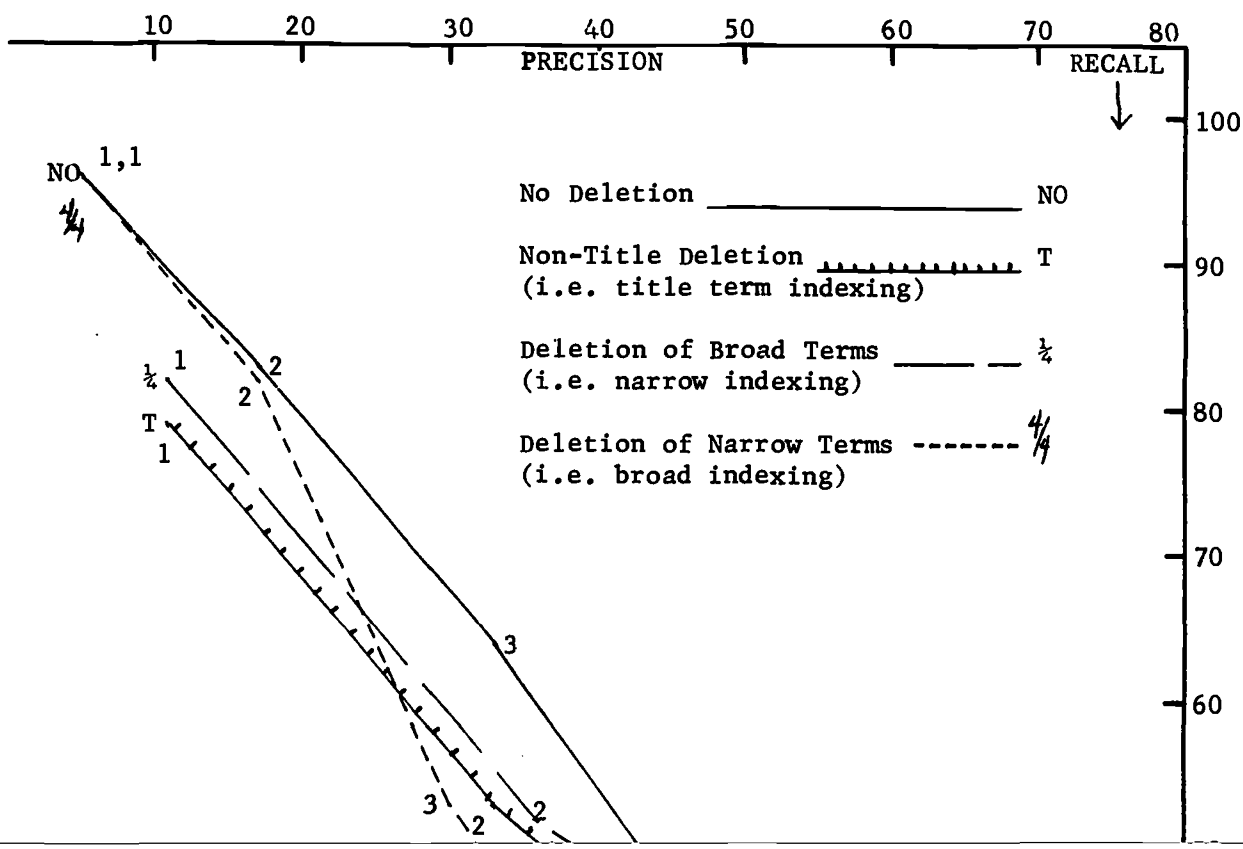
Compared with [illegible] difference is significant at [illegible]

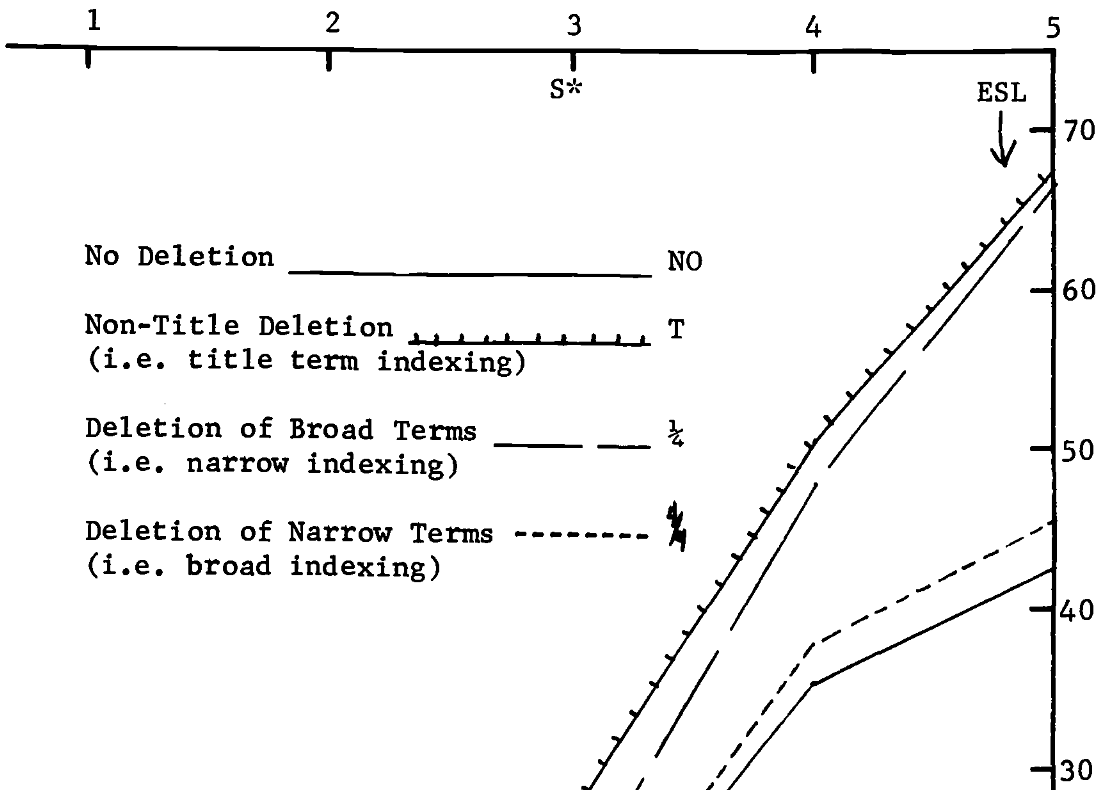
Compared with no deletion [illegible] difference is significant at [illegible]

FIG. [illegible]
DELETION OF ITEM QUARTILES: ESL


10
20
30
40
50
60
70
80
PRECISION
RECALL
No Deletion NO
Non-Title Deletion T
Random Deletion RT
Non-Weighted-10 Deletion W
Random Deletion RW
1st Quartile Deletion ¼
Numbers on the curves represent cutoff levels
100
90
80
70
60
NO
¼
T
W
RW
1
2
3


1
2
3
4
5
S*
ESL
110
100
90
80
70
60
No Deletion NO
Non-Title Deletion T
Random Deletion RT
Non-Weighted-10 Deletion WT
Random Deletion RW
1st Quartile Deletion ¼
Compared with no deletion all values are at least .05 significantly worse, except for non-title deletion (S* - 1,2,3) and 1st Quartile deletion (S* = 1,2,3,4).


10
20
30
40
50
60
70
80
PRECISION
RECALL
100
90
80
70
60
NO
1,1
No Deletion NO
Non-Title Deletion T
(i.e. title term indexing)
Deletion of Broad Terms ¼
(i.e. narrow indexing)
Deletion of Narrow Terms 4/4
(i.e. broad indexing)
1
2
2
T
1
3
3
2
2


1
2
3
4
5
S*
ESL
70
60
50
40
30
No Deletion NO
Non-Title Deletion T
(i.e. title term indexing)
Deletion of Broad Terms ¼
(i.e. narrow indexing)
Deletion of Narrow Terms
(i.e. broad indexing)